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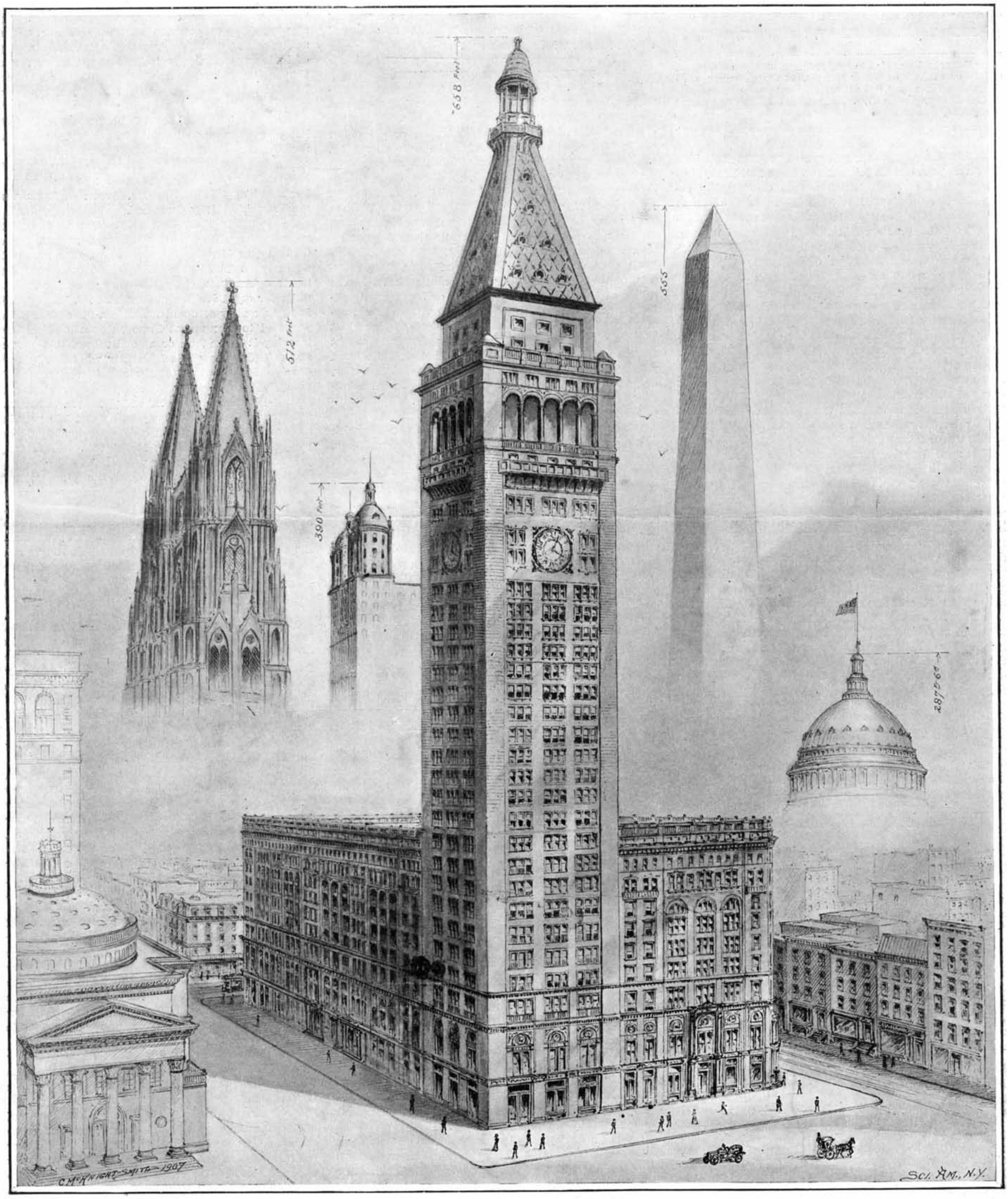
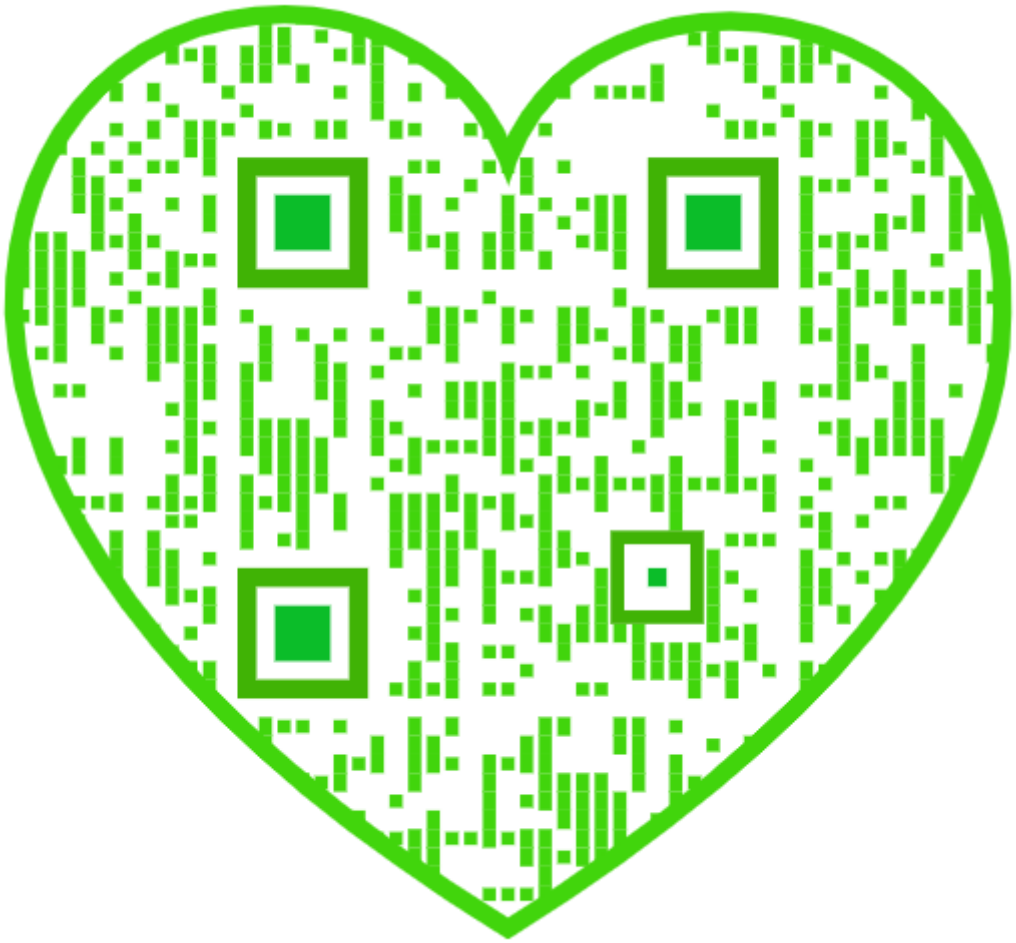


Dr. Parkhurst's Church. Cologne Cathedral. Park Row Building. The Metropolitan Life Campanile. Washington Monument. Dome of the Capitol.

This Stupendous Shaft of Pure White Marble Will Tower to a Height of 658 Feet Above the Sidewalk. The Topmost Office Floor Will Be 526 Feet Above the Ground.

A TWENTIETH CENTURY CAMPANILE IN NEW YORK.—[See page 270.]



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NEW YORK, SATURDAY, MARCH 30, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A CITY OF TOWERS.

Within the past few months we have illustrated on the front page of this journal two office buildings, both in course of erection, which are to considerably exceed half a thousand feet in height. Both of these structures are built as additions to existing office buildings, and the predisposing motive in carrying them up to such unprecedented heights is the desire to obtain a maximum amount of office space on a given amount of ground area. Incidentally, in the case of each building the publicity afforded by such towering structures has also been no inconsiderable motive. But whatever may be the *raison d'etre* of these office towers, there can be no question that the skyward race having begun with such daring aspiration, other builders will be seized with the vertical "speed madness." And so we may look to see a repetition of the tower-building craze of medieval times, which led the wealthy men of Siena and Bologna to build those curious and not unsightly shafts, which form one of the historical and architectural attractions of those cities.

If it should prove that we are to witness an era of tower building in Manhattan, the question arises as to what limits of a physical character exist which must set a limit upon height, always supposing that the municipal authorities impose no restrictions by law. Judged from the standpoint of structural engineering, there is no reason why, if any firm were desirous to have it done, an office building should not be run up to a height of 1,000 feet; provided, of course, good rock foundation were found. It would merely be a question of enlarging the section of the columns, and introducing a system of completely triangulated trussing, which would probably, at least in the lower half of the building, have to extend entirely around the four sides of the tower at every floor. In the present state of the art, the limit upon height would be imposed by the elevator question. For unless some lighter and more speedy system should be devised, it would be necessary to make the full ascent of a thousand feet in three distinct flights. Moreover, the large amount of space that would have to be given up to elevators would make such serious inroads on rentable floor space, as to render it necessary, if any reasonable profit were to be made upon the venture, to charge prohibitive rentals.

NAVAL MARKSMANSHIP.

It seems like a truism to state that the man behind the gun is the most important factor in the efficiency of a warship; and yet, the fact that it is only of recent years that training in marksmanship has received adequate attention, would seem to show that the supreme importance of the gunner is only now being fully understood. The improvement in marksmanship in our own navy has been enormous since the Spanish-American war when, as was pointed out in this journal at the time, the number of hits at the battle of Santiago was only two per cent of the shots fired. It is safe to say that under present conditions of marksmanship, our gunners would have placed the figures at nearer twenty than two per cent.

The Japanese, in repelling the sortie of the Russian fleet at Port Arthur, did some very indifferent shooting; but, profiting by their experience, they put in an enormous amount of target practice in the interval between that engagement and the great fight of the following May, when the 12-inch guns of Admiral Togo's battleships were credited with making nineteen per cent of hits out of the total number of shots fired. In the British navy there has also been a notable improvement, and some brilliant records have been made, there being, in fact, quite a neck-and-neck race between the gunners of that navy and our own for the world's record. The British Admiralty has recently published a table showing the results of the gun layers' test in the fleet for the year 1906, and the high average of hits made is compared with the results in five previous years during the decade. Thus, comparing the years 1897 and 1906, the percentage of hits to rounds fired in 1897 was 31.83; in 1904 it was 42.83; in 1905 it reached 56.58, and last year it rose to 71.12. Under the table of hits per gun per minute we note that for the 10- and 12-inch guns, the figure rose from 0.09 in 1897 to 0.81 in 1906. For the 9.2-inch gun there was recorded in 1897, 0.17 hit per gun per minute, and this had risen in 1905 to 1.40, and in 1906 to 2.84 hits. The 6-inch gun averaged 1.33 hits per gun per minute in 1897, 2.23 hits in 1904, and 4.96 hits per gun per minute in 1906. The record for the whole navy for the year was held by the cruiser "Drake," which brought Prince Louis of Battenberg to this country in 1905. On this ship with the 9.2-inch gun, seventeen hits were made out of eighteen rounds at a moving target, and in one minute eleven hits were made out of eleven rounds with a 6-inch gun.

ELECTRIC TRACTION VINDICATED.

It would be a thousand pities if the recent derailment of an electric train on the New York Central tracks should serve to shake the faith of the public in electric locomotives and electric trains, or delay the application of electric traction to the railroad system of this country. Absolutely nothing has transpired thus far in the investigations to show that the disaster was due to the electrical equipment, as such. In our recent editorial on the "Peril of the Electric Locomotive on Steam Roads," there was no intention, nor was there any effect, of creating the impression that the fine electrical equipment, both of the New York Central and the New Haven lines, was defective, or that the "peril" lay in the mechanical features either of the line, the locomotives, or the general rolling stock. On the contrary, as far as the electric appliances are concerned, the results of the accident were a vindication of its efficiency; for it is a fact that the instant the train was derailed, and the third rail broken, the automatic cut-outs operated instantly, and that particular section of the line where the accident occurred became "dead." No one was "electrocuted" nor was any fire started by short circuits.

What we did say, and what we reaffirm to-day with added emphasis, is that because of the new conditions introduced with electrical traction and inseparable from it, there is a call for higher intelligence and more conscientious care on the part of the operating and maintenance departments in order to meet these conditions. The unusually low center of gravity, the enormous reserve of power, and the capacity for high speeds of the electric locomotive, are not faults, but excellences of the machine. But the low center of gravity and the capacity for high speed call for special conditions in the track, particularly on curves, in order to meet the more severe stresses which will inevitably result. It is highly creditable that the designers of the electric locomotive should have succeeded in providing, in an engine of the same or even less total weight than the steam locomotive, a power and speed capacity so very much greater. The peril lies not in the machine but in the man, lest through ignorance or lack of judgment, he should draw upon his reserve too freely and drive his train at speeds far beyond the limits of safety for the particular stretch of road over which he may be running.

The evidence which has been brought out thus far in the investigations confirms our opinion that it was the under-elevation of the outer rail combined with the unquestionably excessive speed of the locomotives that sheared the spikes, flung the rail aside, and allowed the cars to run wild over the tracks. For many years this journal has been advocating the use of greater super-elevation of outside rails on curves. We believe that in the practice of under-elevation lies one of the greatest perils of present-day railroading, and that the coming introduction of electric traction, with its inevitably higher speeds, intensifies this danger enormously. The only plausible objection to high super-elevation is that when slower trains, and especially freight trains, pass around highly super-elevated curves at low speed, the additional weight thrown on the lower rail tends to batter it down and cut the ties badly. Granted. But is it not better to wear out ties and rails a little faster and have a track which is safe for every train, fast or slow, than to save a little of the cost of maintenance at the risk, the enormous risk, of human life entailed by the present execrable and ridiculous practice of running express trains at from thirty to fifty per cent higher speed than that for which the track is super-elevated?

It was testified before the coroner that the curve at Woodlawn was elevated to give equilibrium at 45 miles an hour, but that the elevation was perfectly safe for 60 miles an hour, this being said, by the particular witness referred to, to be the common practice among engineers. The fallacy and the peril of such practice, however, lies in the fact that although 45 miles an hour is the mean between 30 and 60 miles an hour, it is not by any means the mean between the centrifugal stresses induced at those two rates of speed; for the centrifugal thrust increases as the square of the speed, and the speed which would give the mean stress on the outer rail would be well on to 55 miles an hour. For such a speed should the rail be elevated, and not for 45 miles, if 60 miles per hour is to be considered the safe allowable limit for that curve.

METALLIC SODIUM AS A CONDUCTOR FOR ELECTRIC CURRENTS.

Metallic sodium was first prepared by the action of a powerful electric current on caustic soda which had been previously considered as an element. It is now prepared by distilling a mixture of sodium carbonate and charcoal. The metal is exceedingly light, having a specific gravity of 0.98, and consequently it floats on water. When freshly cut the surface has a bright, nearly white, metallic luster, and it is almost as soft as wax. When thrown on water it sets up a chemical action with great energy which causes the evolution of hydrogen and finally it ignites. In consequence of this action sodium cannot be kept in the air but must be preserved under oil or in hermetically-sealed vessels.

Such a metal would seem to be the last in the whole list of substances that would be selected as a possible medium for the transmission of electric currents, yet this scheme is now being quite earnestly discussed in electrical circles, due, largely, to some recent deductions and experiments by Mr. Anson G. Betts, which are herewith briefly described.

According to Prof. Francis B. Crocker, the first to suggest the utility and economy of sodium for conductors was Mr. Charles S. Bradley, who pointed out as early as 1897 that a sodium conductor would be much lighter than one made of copper or even aluminium for equal lengths and resistances. Since sodium is so extremely soft and unstable a metal Mr. Bradley proposed to circumvent these untoward difficulties by incasing it in an iron or a steel tube with screw caps at the ends. Now this is exactly what Mr. Betts has done in his experimental investigation of the subject, using lengths of wrought iron pipe approximating 17 feet and having a diameter of 1½ inches. There were ten pipes in all, and it required about 120 pounds of sodium to fill them, which cost approximately 50 cents per pound, although it is stated that sodium can be produced for 7½ cents per pound.

The method employed to fill the pipes with the sodium and to obtain as good an electrical contact between the surfaces of the different metals as possible was to heat the pipe considerably above the melting point of the sodium, and melting the sodium in an iron vessel from which it was caused to flow into the tube. After the sodium and the pipe had cooled a graphite and oil mixture was applied to the ends to make it air and water tight and the sections connected together.

The total length of the conductor was about 130 feet and this was put up outside of Mr. Betts's laboratories and connected two of the buildings. After being in use for several months it was removed and put up in a nearby field in virtue of the additional fire risk it incurred, which was not small, as will be seen.

The advantages of a sodium conductor over those made of copper or aluminium lie in the economy of its installation and in its upkeep; thus a copper conductor that cost $1,000 can be replaced by a sodium conductor for $300; the annual cost for the former being $120, namely $60 for interest and $60 for the loss of energy; the annual cost for the latter would be $78, i. e., $18 for interest and $60 for loss of energy.

A sodium conductor costing $550, however, would be more economical than one costing $300, for this obtains when the interest and the power loss are even or nearly so, that is, the interest would be $33 and the loss of energy $32.75, or a total of $65.75 per year.

Among the disadvantages that can be cited against the use of sodium conductors it may be said that they are applicable only where heavy currents are to be carried. Again it would certainly be unsafe to use them if there was a possibility of fire, for heat would cause the sodium to expand to a point where it would break the pipe containing it so that the metal would burn up; if it were attempted to extinguish the fire with water its peculiar characteristics would result in a dangerous display of hydro-pyrotechnics.

Besides these obvious objections there are several factors that have not been accurately determined which, should these prove unfavorable under test conditions would relegate the sodium conductor to the limbo reserved for all impracticable schemes. One of these unknown factors is whether or not the sodium and iron in contact will not in time set up a chemical action and so decrease the value of sodium as a conductor. Other factors are the relative expansions of sodium and iron, etc.

Mr. Betts has shown that the iron pipe carried 20 per cent and the sodium in the interior 80 per cent of the current. On the assumption that the unknown quantities of sodium will prove satisfactory it will not be at all surprising to learn of a commercial installation of this material at any time.

THE HEAVENS IN APRIL.

BY HENRY NORRIS RUSSELL, PH.D.

At no time in the year can we see so many bright stars in the early evening as in April. The finest group of them is low in the west, but the eastern skies are not barren, as we shall soon see.

Facing due west, and holding our map so that the words "Western Horizon" are at the bottom, we can at once identify Orion, Taurus the Bull, and Canis Major the Great Dog. The four most brilliant stars in these constellations—Rigel and Betelgeuse in Orion, Aldebaran in Taurus, and Sirius in Canis Major—form a remarkably regular diamond-shaped figure. Above Orion on the left is the Little Dog (Canis Minor), which has one bright star known since Greek times by the name of Procyon. To the right of this lies Gemini (the Twins), whose brightest stars are very appropriately called Castor and Pollux. Farther to the right is Auriga the Charioteer, whose principal star, Capella, is brighter than any we have yet noticed except the incomparable Sirius.

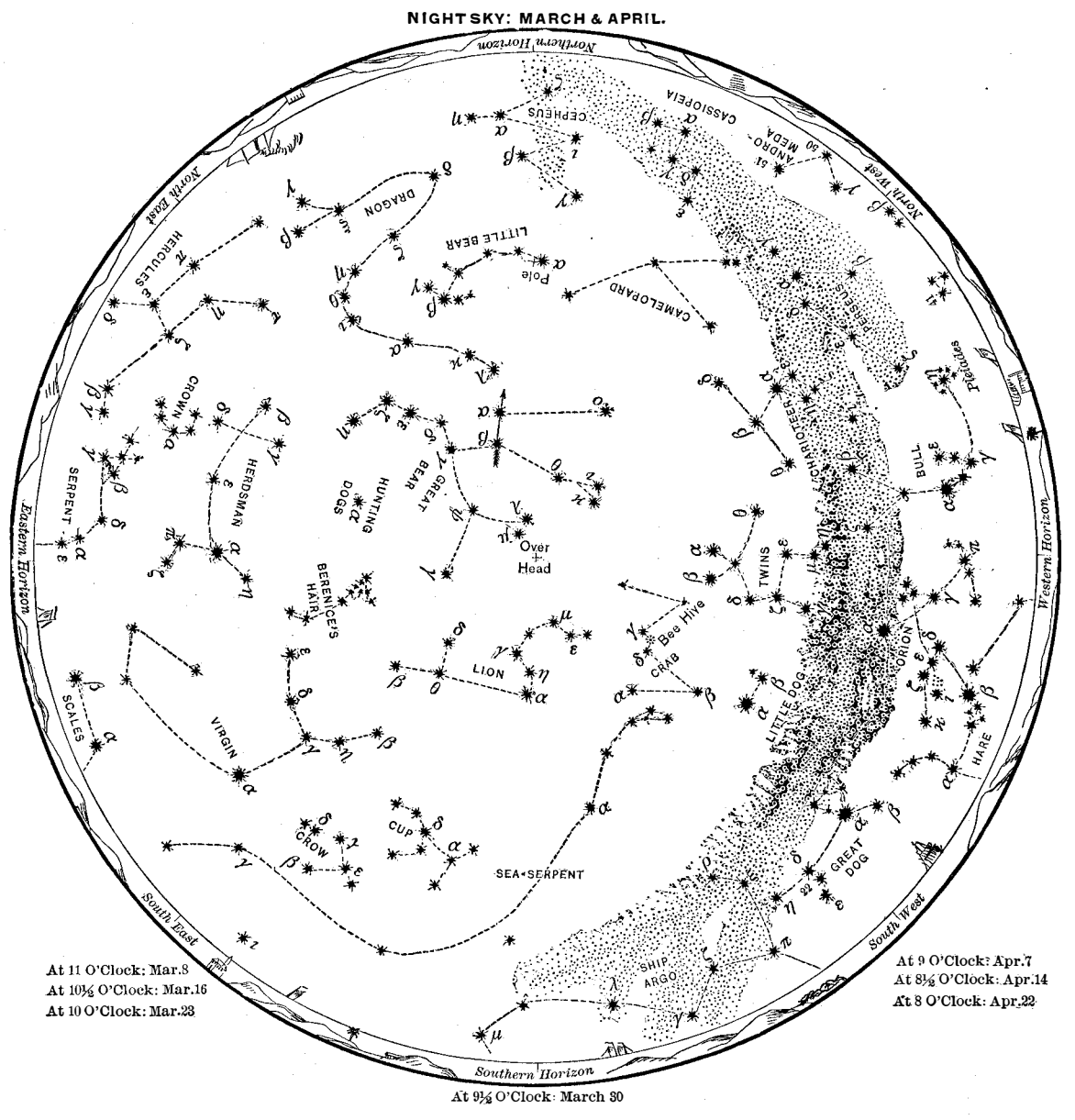
The constellations overhead and in the southern sky make a poor showing compared with those we have left, but contain much of interest. High up, and south of the zenith, is Leo the Lion. The "sickle" which marks his head and the triangle forming his hind quarters are conspicuous alike on our map and in the sky. Between the Lion and the Twins is the Crab (Cancer), which has no bright stars, but contains the interesting star cluster Præsepe (the Beehive), which looks like a fuzzy patch of light to the naked eye, but breaks up into its separate stars when viewed through a field glass.

Below Cancer, and about on a level with Procyon, a small but rather conspicuous group of stars marks the head of the Sea Serpent, Hydra. This is an enormous constellation which stretches clear down to the southeastern horizon, including many stars too faint to be shown on our map, but easily visible to the eye. It has one bright star (lettered α) and sometimes called Alfard. This name, meaning "The Solitary One," is very appropriate, as the star stands very much alone, with no equals nearer than Regulus in Leo and Procyon.

On the back of Hydra, lower down, are the Cup (Crater), which is not very conspicuous, and the Crow (Corvus), which is rather prominent. Below Hydra in the southwest is a part of the Ship (Argo), which is never well seen in our latitude.

In the southeast the principal group is Virgo, which contains one star nearly of the first magnitude, Spica, and a good many of the third and fourth. To the left of this is Boötes (the Herdsman), an important constellation including the great yellow star Arcturus, which is one of the finest objects in the heavens.

Hercules and Serpens (the Serpent), which are rising in the east and northeast, are not yet well visible. We turn from them and look right overhead, to find the Great Bear displayed to the fullest advantage. Part of this noble constellation has already passed the meridian, and the Pointers will soon be above the pole The Bear's tail, otherwise known as the handle of the Great Dipper, hangs far down to the northeast, and her paws (marked by three pairs of stars all lying near the same straight line) reach nearly to the zenith. In the space between the Great Bear, Boötes, Virgo, and Leo are two small constellations. The southern, Berenice's Hair, is a diffuse cluster of faint stars, while the other, the Hunting Dogs, contains but one bright star, which in the telescope proves to be a fine double (as are also the stars ζ in the Great Bear and γ in Virgo and in Leo). Finally, in the north, we find the Little Bear, inclosed within the coils of the Dragon. Cepheus and his wife Cassiopeia are close to the northern horizon, and Perseus is well down in the northwest, following Andromeda, out of sight.



In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed; counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

THE PLANETS.

Mercury is morning star in Aquarius and Pisces. He is farthest from the sun on the 14th, when the distance of the two appears to be about 27½ degrees. At this time he rises about 4:30 A. M. and should be easily seen. He is not ill placed for observation for some weeks on each side of this date, and may be regarded as visible throughout the month.

Venus is likewise a morning star in Aquarius, and rises rather more than half an hour before Mercury. As is always the case, she is much the brightest object in the sky, next to the sun and moon.

Mars is in Sagittarius, exceedingly far south, and rises near midnight toward the middle of April. He is approaching us rapidly, and at the end of the month is about 70 million miles away. Though nearer than the sun, this is almost twice as far as he will be from us at opposition in July.

Jupiter is in Gemini, in exactly the opposite quarter of the sky from Mars, and sets near midnight in the middle of the month.

Saturn is in Aquarius, and rises a little after 4 A. M. on the 15th. He is near Mercury and Venus, all through the month, and is in conjunction with the first on the 9th, and with the second on the 21st, the least distance of the two planets being in both cases a little more than the moon's apparent diameter.

Uranus is in Sagittarius. On the 3d he is in quadrature with the sun, and comes to the meridian at 6 A. M. Neptune is in Gemini, and may still be observed in the early evening.

THE MOON.

Last quarter occurs at 10 A. M. on the 5th, new moon at 2 P. M. on the 12th, first quarter at 3 P. M. on the 20th, and full moon at 1 A. M. on the 28th. The moon is nearest us on the 2d, farthest away on the 18th, and nearest once more on the 30th. She is in conjunction with Mars on the 4th, Uranus on the 5th, Venus on the 9th, Mercury and Saturn on the 10th, and Jupiter and Neptune on the 18th.

GIACOBINI'S COMET.

A comet, visible in a small telescope, was discovered by Giacobini at Nice on the evening of March 9. It was then in Canis Major, nearly due east of Sirius, and was moving pretty rapidly northwestward in the direction of Alpha Orionis.

The elements of its orbit, which have just come to hand, show that at the time of discovery it was about at its nearest to the sun and already past its nearest approach to us. It is now receding from both earth and sun, and consequently growing rapidly fainter, so that it will not be visible very long. At its nearest approach it was more than 100,000,000 miles from the earth.

Princeton University Observatory.

THE DEATH OF PIERRE BERTHELOT.

Through the death of Prof. Berthelot, the world has lost a man eminent not only as a philosopher and a scientist, but also a figure prominent in the national politics of France and in the affairs of the world in general. Aside from Berthelot's chemical researches, his labors in behalf of the beleaguered French in Paris during the "Terrible Year" of the Franco-Prussian war, and his political activity brought him to the notice of the world. As the head of the Scientific Committee of Defense of Paris in 1871, he undertook the investigations which practically led to the invention of smokeless explosives. In his researches and discoveries in the synthesis of fats, glycerines, carbohydrates, and alcohol, in coal-tar dyes, in thermo-chemistry and in explosives, he added enormously to the scientific knowledge of mankind. As a Deputy and a Senator his influence in legislation was extensive, and as Inspector-General of Higher Education his work was memorable. That Prof. Berthelot was qualified not only for the activities of the lecture room and the laboratory, was shown by his work as Minister of Public Instruction and as Minister of Foreign Affairs. While holding the latter office he fully demonstrated his ability as a political economist and a diplomat. A man of brilliant intellect and great scientific erudition, Berthelot had a most charming and engaging personality, and such were his personal qualities, that to see him was to honor, and to know him was to love.

Pierre Eugène Berthelot was born at Paris in 1827. He was educated at the Collège Henri IV., where he devoted himself principally to research work in organic chemistry. He obtained the degree of Doctor in Science in 1854, presenting a remarkable thesis in which he described his artificial reproduction of fats. Berthelot was the first to produce these important organic products synthetically, notwithstanding that since 1823, when Chevreul effected the decomposition of fats into their constituents, it had been known that they are mixtures of compounds of glycerin with the fatty acids. In the same thesis he showed that glycerin is an alcohol, and thus the idea of polyatomic alcohols was first introduced. In 1851 Berthelot became the assistant to Balard at the Collège de France. In 1860 he was made Professor of Organic Chemistry at the Ecole de Pharmacie, and in 1865 a new chair of chemistry was founded for him at the Collège de France, where he lectured more or less regularly on theoretical chemistry until his death. In 1873 he was elected Member of the Institute, and in 1889 Perpetual Secretary, succeeding Pasteur, of the Academy of Sciences. In 1876 he was made Inspector-General of Higher Education; in 1881 a life member of the Senate. In 1886-87 he was Minister of Public Instruction, and in 1895-96 he was Minister of Foreign Affairs. Berthelot was also a Grand Officer of the Legion of Honor, and he was a member of the most distinguished scientific bodies of Great Britain, the United States, and other lands.

The cost of coal for steam locomotives is approximately 15 per cent of the total operating expenses for steam railroads, and is the largest of the expenses for materials, says the Electric Railway Review. Data contained in the annual reports of a number of the larger systems indicate that the annual coal consumption is, on the average, about 2,500 tons for each steam locomotive. From the United States census report on "Street and Electric Railways," covering 799 operating companies, the cost of fuel for power for electric railways appears to be about $15,000,000, which is a little over 10.5 per cent of the total operating expenses.

THE GASOLINE MOTOR IN SHALLOW-DRAFT VESSELS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

An interesting experiment in the application of the gasoline motor in regard to marine propulsion is being carried out by the Sir John I. Thornycroft Company, of London. This firm has just completed the construction of two shallow-draft vessels for freight service upon the waterways of southern Nigeria. Hitherto the propulsion in such craft has been by the ordinary type of reciprocating marine steam engines, modified and adapted to fulfill the exigencies of this class of vessel.

The Thornycroft Company are employing two distinct types of propulsion in these two vessels, though the motive power will be identical. The dimensions are practically the same in each case. In one boat screw propellers of the ordinary type are employed, while in the second vessel a stern paddlewheel is to be adopted, driven from the engine through clutch and chain gearing. By this means comparative data are to be obtained concerning the two systems of propulsion, so that the most advantageous method for this class of vessel, so far as regards internal-combustion engines, may be ascertained.

The first of the two craft, the "Spider," in which the ordinary type of twin screws in a tunnel is employed, has passed through its trial trips with complete success. The vessels have been largely designed and built to the order of Sir Edward Reed, formerly chief naval constructor to the British government, and many distinctive features have been incorporated. The craft is constructed of galvanized steel, and measures 56 feet 3 inches in length over all, by 9 feet beam, and with a load of four tons has a draft of 12 inches. The hull, which is open, with a short deck over the fore peak, is divided by bulkheads into six watertight compartments. The stern is perfectly square, and to provide a level deck the bottom is floored with ¾-inch pitch pine. Above the vessel, almost throughout its full length, extends a light wooden awning the full width of the boat, of ½-inch pine, covered with asbestos, to shelter the crew from the heat of the tropical sun, while side protection is afforded by green canvas curtains.

The engine, which is placed almost amidships, and is of the ordinary Thornycroft, four-cylinder, vertical, marine type, is capable of running on either gasoline or kerosene though normally intended to operate with the latter type of fuel. The engine is fixed to a baseplate secured to the steel framework of the hull. In order to minimize vibration and to deaden noise, a piece of hardwood packing is interleaved between the baseplate and the steel framework. The cylinders have a bore of 6 inches with a stroke of 8 inches, and the engine is fitted with mechanically-operated inlet and exhaust valves placed on opposite sides. The Simms-Bosch, low-tension magneto ignition system is used, though the ordinary high-tension method with accumulators and coil can be employed in case of emergency. The engine is governed by a ball governor, operating upon the throttle and thereby regulating the quantity of the gaseous mixture for the cylinders, the fuel supply being under a pressure of 4 pounds, maintained by a small air pump, which is operated from an eccentric keyed onto the governor spindle.

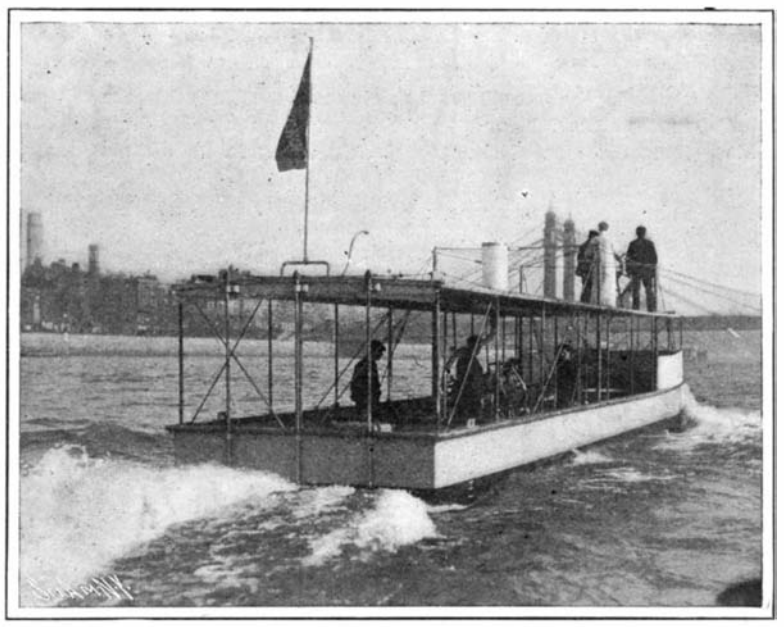
Attached to the bulwarks on either side of the engine compartment are carried two fuel tanks, each having a capacity of 40 gallons. As two classes of fuel can be utilized they can be carried in the respective tanks. If gasoline is being used, the supply is carried to the ordinary type of vaporizer; but in connection with the heavier kerosene a special vaporizer is employed. This comprises a metal box, into which the exhaust gases from the engine are carried, and in this box is a U-shaped tube, through which the kerosene passes and is gasified by the heat from the exhaust gases. The vapor then passes into the engine cylinders. There is a series of cocks, which enables the engineer to switch off from one class of fuel to the other as desired. All the levers controlling the various mechanisms are conveniently placed in front of the engineer, who has thus complete control over the engine from one position. In starting, the motor is run on half compression.

The screws are placed in a tunnel and fixed on one shaft, in accordance with the Thornycroft practice in vessels of this type. The power is transmitted from the engine to the propeller shaft through a friction clutch. A peculiar feature of the vessel is the position of the steering wheel, which is carried on the awning deck in front, being connected by flexible cables to the three, single-plate, balanced rudders, which appreciably facilitate steering on such a light draft.

The "Spider" on the official trials developed a mean speed of 8 knots per hour, which is 2 knots in excess of the contract speed—a highly satisfactory result. Gasoline fuel was used; though with the heavier fuel the decrease in speed was only one knot. The motor running at a normal speed of 800 revolutions per minute with kerosene fuel developed approximately 48 horse-power; but with gasoline at the same number of revolutions, 52 horse-power is developed. The contract, however, is for a low number of revolutions—approximately 380 revolutions per minute, at which speed about 25 horse-power is developed.

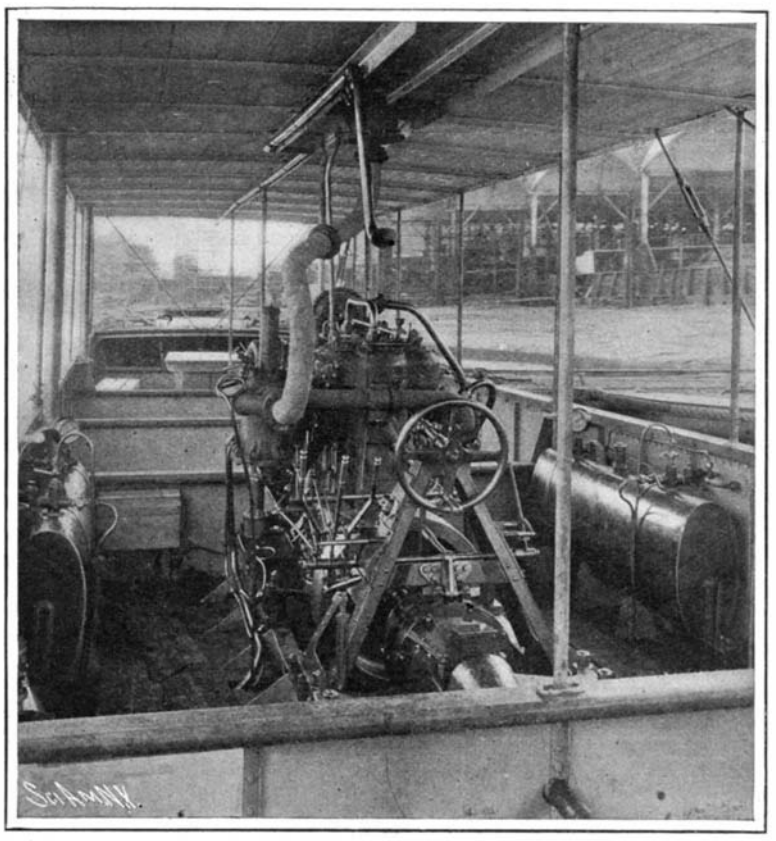
The economy effected in weight by the employment of an internal-combustion engine as compared with the ordinary marine steam engine is more than fifty per cent, since a steam engine developing 50 horse-power at 400 revolutions per minute, complete with condenser and locomotive type of boiler, would weigh 2.85 tons, whereas the four-cylinder motor in the "Spider," complete with the reversing gear, and developing at its normal speed 52 horse-power, weighs only 1.25 tons. A great saving in space in connection with the machinery is also obtained, thereby rendering available greater area for the stowage of freight.

In the case of the stern-wheel vessel, the disposition of the machinery will be different. A special platform is to be provided at the stern of the boat, upon which the four-cylinder motor is to be set transversely, thereby bringing the driving sprocket on the engine gearing in alignment with the sprocket on the paddle-wheel, the transmission being effected through chains. By this arrangement the whole of the deck of the boat will be left clear and open, thereby affording a greater area for freight. This latter vessel will be 6 feet 9 inches longer than the "Spider"; but in every other respect it will be identical. These two boats will be running side by side, and thus some interesting data concerning the respective merits of screw and stern-wheel propulsion for vessels of light draft in connection with the gasoline motor will be obtained.



The "Spider," a Shallow-Draft Vessel Propelled by a Gasoline Motor.

Note the broad square stern and triple rudders.



The 4-Cylinder Motor of the "Spider" Developing 52 Horse-Power.

Showing control levers, the fuel tanks for gasoline and kerosene respectively on bulwarks at side and the small air pump on the engine driven by the governor spindle for maintaining pressure in the fuel tanks.

AN INTERESTING APPLICATION OF THE GASOLINE MOTOR TO SHALLOW-DRAFT VESSELS.

The Recovery of Tin from Tin-Plate.

By far the largest proportion of the tin used in the arts is employed for making tin-plates, and these, in turn, are mainly used for making the tins in which various comestibles are preserved. The total weight of the tin on the plating is said to average five per cent of the total weight of the sheet; and there has been in the past great difficulty in recovering this tin by a commercially profitable process, in spite of the high price of the metal. That contained in the solder used in making the joints of the tin can be, and is, recovered by simply heating the tins sufficiently hot to cause the solder to flow; but this process is useless as a means of recovering the rest of the metal. According to the Electrotechnische Zeitschrift, however, this feat is now being successfully accomplished at Copenhagen by the Bergsoe process. In this a solution of stannic chloride is passed over the tinned surface, when it takes up further tin forming the stannous salt. The latter is then electrolyzed, the additional tin dissolved is deposited, and stannic chloride reformed. The tins can, it is stated, be treated without requiring a preliminary cleansing. A hole is punched in the bottom of each, and a number are then placed in a basket, in which they remain during the whole of the subsequent treatment. When filled, the baskets are placed in a series of tanks, through which flows a two per cent solution of stannic chloride. As this solution flows from tank to tank it gradually becomes richer and richer in tin by forming the stannous salt of the metal, as explained above. From the last tank of the series it is raised into the electrolytic vats by a pump constructed entirely of brass, so as to be unacted on by the fluid passed through. Here the stannous chloride is again reduced to stannic chloride, which is returned to the dissolving vats, whence it picks up more tin, to be again regenerated by electrolysis. The process is therefore a cyclical one. The tin is deposited in small crystals measuring about 1/50 inch long. Being perfectly pure, it is salable at the same price as Banca. The energy expended in the electrolysis is said to be 47 kilowatt-hours per ton of the metal recovered. Though, as stated, the process is a cyclical one, the same solution cannot be used for more than three or four rounds of the vats, since it becomes charged with chloride of iron.

Enormous Growth of the Portland Cement Industry.

The production of Portland cement in this country has increased in thirty-five years from 3,000 barrels a year to 4,000,000 barrels last year, and this with the prospect of an increase during next year of twenty per cent. Without being in the hands of a trust, the prices have increased in the past eighteen months from fifteen to twenty per cent from legitimate demand.

This enormous output for 1906 would be sufficient to build a first-class cement sidewalk five feet wide three and six-tenths times around the world, or build a sidewalk 456 feet wide reaching from Chicago to New York.

The uses to which this material, mixed with sand or crushed stone, is put are almost unlimited. They range from the smallest culvert to the enormous concrete arches spanning our largest streams; from the humblest cottage made of concrete blocks to the finest skyscraper and office buildings built of reinforced concrete.

To the farmer alone, Portland cement concrete presents an enormous range of possibilities. With it he makes his fence posts, drain tile, culvert pipe, well curbing, feeding floors, watering troughs, stable floors, silos, granaries, stables, residences; in fact, he can almost make it take the place of everything heretofore made of wood.

There is said to be an increasing demand for dredgers in Egypt, on account of the drainage works contemplated by the Egyptian Public Works department. Machines suited for use on the small canals will be chiefly in request, and manufacturers of these are recommended to bring them forward. A steam waterweed cutter would also sell well.

NEW FRENCH AEROPLANES.

Santos Dumont, Capt. Ferber, and several other French experimenters have been hard at work during the past winter building new aeroplanes with which to compete for the many prizes now offered. The illustrations published herewith show two of the new aeroplanes—those of Santos Dumont and M. Delagrange. The former aeroplane was described briefly in a recent issue of the SCIENTIFIC AMERICAN. As can be seen from the photograph, the long beam, which projected in front of his former aeroplane and carried the box-shaped rudder, is now placed at the rear of the planes. The motor is placed high in the middle of the structure, and carries a 66-inch propeller upon its crankshaft, while the operator sits upon a small saddle below and in front of the motor. The new aeroplane is to have a 100-horse-power, 16-cylinder, water-cooled engine, which will weigh with its accessories about 260 pounds, or 73 pounds more than the 50-horse-power motor.

The weight of the machine itself is some 66 pounds less than the weight of Santos Dumont's former machine, which weighed complete, with a 50-horse-power motor, about 460 pounds. The new machine, equipped with a 50-horse-power, 8-cylinder motor as shown in the illustrations, weighs just under 400 pounds, or, with M. Dumont on board, a little over 500. The planes are 36½ feet long by about 2 feet wide, which gives a total supporting surface of about 146 square feet. The load carried per square foot will be from 3 to 3½ pounds, which is rather high and will accordingly make necessary a speed of over 50 miles an hour before the machine will lift. The chief novelty in the construction of the new aeroplane is the use of mahogany instead of bamboo rods. The horizontal surfaces are constructed of thin wood strips in place of the canvas used heretofore, while the vertical divisions are still made of cloth.

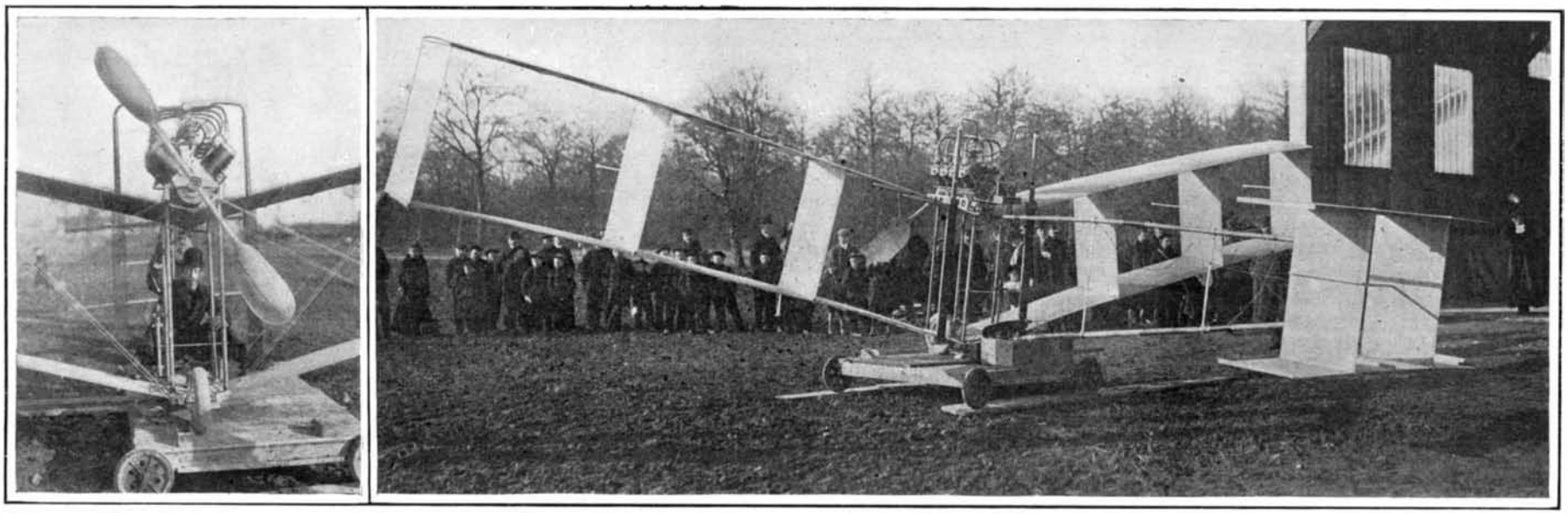
The Delagrange aeroplane, which we also illustrate, had its first test on February 28 at Vincennes. This apparatus is of the cellular type, and has 60 square meters of surface. It is a double-surface machine of the biplane type, the second set of planes being only about half the length of the first. The main aeroplanes are 32.8 x 6½ feet in length and width, while the rear planes are only half as long and have the same width. The main planes are 4.9 feet apart. They are connected together by vertical posts braced with steel wire. The material used is light varnished cloth, which is stretched over curved wooden ribs in the usual manner. The rear planes are connected together by three vertical planes, which are intended to assure the stability of the machine and to keep it moving forward in a straight line. Back of the middle one of these planes is placed the rudder, which is suitably connected to the steering gear arranged beside the operator. The rear planes are carried on a small pneumatic-tired wheel, which can be turned in any direction, while the front planes are mounted upon a framework of steel tubing supported upon two wheels through the intermedium of shock-absorbing springs. The front and rear planes are connected together by steel tubes and are braced with wire.

In the middle of the forward planes, on a suitable bed, is placed the motor, a seat for the operator, the steering and control levers, and, on the end of a long beam some 9 feet forward, the horizontal rudder, which is also made up of two planes having a total surface of 7 square meters (75.34 square feet).

At the rear part of this bed is placed an 8-cylinder motor of 50 horse-power, which makes 1,500 R.P.M. The propeller is fastened upon the motor shaft, and has a diameter of 2.1 meters (6.89 feet) and a 1-meter (3.28 foot) pitch. The blades are of cast aluminium, and are riveted to the arms of steel tubing which screw into a steel hub. This propeller is so constructed that all its parts produce traction except the central part about the hub, which undergoes merely a bending strain. It develops a thrust of 150 kilogrammes (330 pounds) when the motor is turning up 1,400 R. P. M. and developing 40 horse-power.

From previous experiments of M. Voisin (the constructor) with this type of aeroplane mounted on floats and drawn by a motor boat, this gentleman has figured that the present aeroplane (which has 645.84 square feet of supporting surface) should lift at a speed of about 52 miles an hour. From the former experiments also, an aeroplane of this type was found to be quite stable.

At the first trial of the new aeroplane on the drill grounds at Vincennes, the machine was put together amid a crowd of curious spectators. When everything was ready, M. Voisin took his seat, and the 50-horse-power, 8-cylinder, V motor was started. The machine shot forward some 150 feet, and then the front part started suddenly skyward as shown in the photograph, and the tubes connecting the front and rear planes were bent. It is claimed the accident was due to improper assembling when the machine was put together on the site of the test. M. Delagrange, its sculptor inventor, will have it reconstructed and then make further trials.



Front and Rear Views of Santos Dumont's New Aeroplane in Which Thin Wood Sheets Form the Supporting Surfaces.

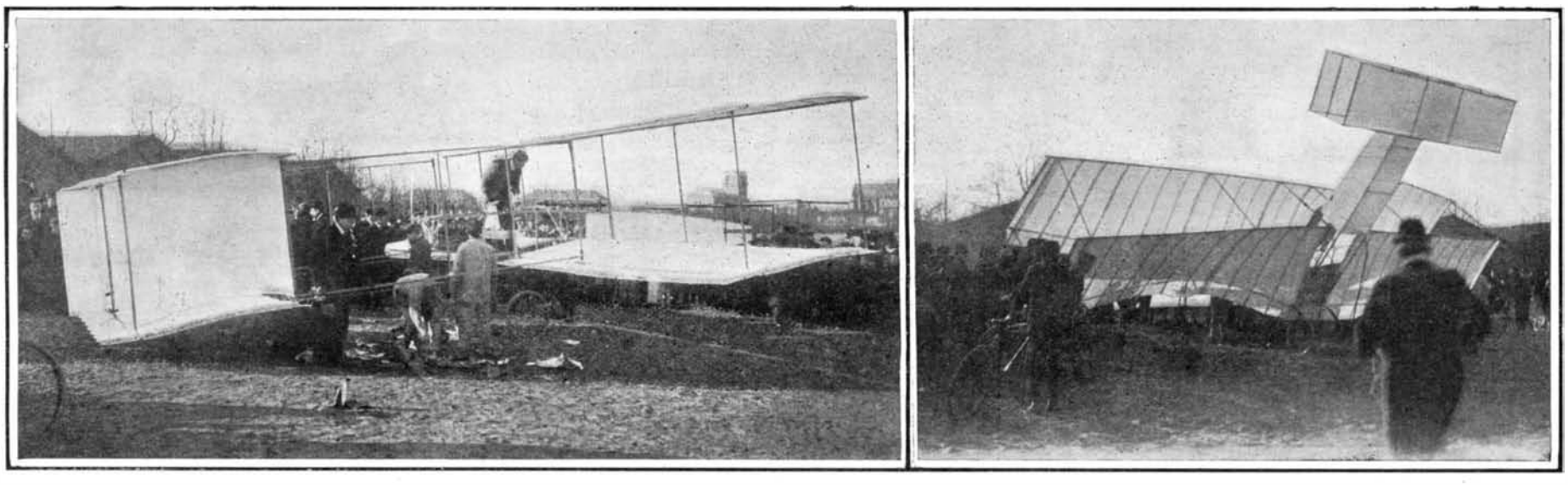
Note the peculiar propeller with spoon-shaped blades which pulls the machine along on its single wheel; also the placing of the combined horizontal and vertical rudders at the rear instead of in front, and the mounting of the motor on top of the planes.

Motoring in the Desert.

Motor cars are now taking the camel's place for travel in the Eastern Desert. They are found to be a less difficult means of conveyance, as well as a more economical one. Cairo, Egypt, has four times as many automobiles this year as last, and the number is rapidly increasing. As there are no hills to climb, the cheaper machines of small horse-power are most generally used. The mining department of the ministry of finance is constructing roads for police service in the Eastern Desert, and the progress has been considerable. An excellent track of ninety miles has been completed between Edfou and Beza. From Beza it will branch to the north and south.

The department of mines has had a new type of motor built for use in the desert, which has proved very satisfactory. The longest day's trip in the Eastern Desert was 148 miles, which was made last summer. During the last trip made by the mining department's tricar, 243 miles were covered in four days, during which time the ordinary work of inspecting the roads and mines was carried on. Three-wheel motor cars are more successful for desert travel than motor cycles, which cause a great strain on the rider. Ordinary pneumatic tires are used, protected by leather and iron-studded bands. Water is only necessary at 50-mile intervals.

The Port Said Motor Car Company started service recently, running to the Arab village. Each car accommodates 25 passengers, and the trip is made in less than half the time taken by the trams. The economy of motoring in the desert is shown in the detail of the work accomplished by the two tricars and the motor cycle during their desert journeys. The six-horse-power tricar covered a total mileage of 2,280, averaging 25 miles per gallon of petroleum; average lubricant, 1.6 pint per 100 miles. The nine-horse-power tricar covered a total mileage of 1,051; averaged 25.8 miles per gallon petroleum and 2.4 pints lubricant. Motor cycle, mileage, 1,462; 63.8 miles per gallon petroleum, and the average lubricant per 100 miles, 0.35 pint.



Side View of Delagrange Aeroplane Ready for Its Trial.

The Broken Front Planes Turned Upward After the Test.

This machine is of the bi-plane or following surface type, there being two sets of double surfaces, one behind the other. The motor is mounted on the lower forward plane, the propeller being on the motor crankshaft just back of the plane and the operator's seat being placed in front of the motor. The rear planes are connected by three vertical partitions, with a small vertical rudder behind the middle one. A double horizontal rudder is fitted in front.

TWO OF THE LATEST FRENCH AEROPLANES.

Report of Tests of Steels by the Mechanical Branch of the Association of Licensed Automobile Manufacturers.

The Mechanical Branch of the Association of Licensed Automobile Manufacturers has just issued to its members a report on materials which have been tested and experimented upon at the Hartford laboratory for the past year, also the complete specifications for various kinds of steel which have been found to be most desirable for specific parts of automobile construction. During the year scores of samples of special steel of unusually high grade have been tested. They were tested in the natural condition, as received from the steel works, tested annealed for heat treatment, and tested to ascertain the toughest possible condition combined with strength. Some of the steels experimented with were silicon and manganese with chromium, vanadium, silico-manganese, chrome nickel, and nickel.

Vanadium, which is just becoming known to some manufacturers, has been under experiment for nearly a year at the Hartford laboratory. Many of the members of the Association of Licensed Automobile Manufacturers have been using vanadium steels for over a year, but only since the elaborate tests which have been made by the Association's metallurgical force has the recommendation and adoption been universal with the Association members. The results of the experiments have proven the desirability of vanadium steels for special parts of automobile construction. It is a most elusive element and its introduction to the basic material must be carefully made. It seems to act as a cleanser if judiciously used, and eliminates many elements which otherwise would be a detriment to the steel. J. Kent Smith, the English metallurgist and exponent of vanadium, in his address to the members of the Mechanical Branch, stated authoritatively that "vanadium steel was the finest steel for mechanically-moving machines." The elements of vanadium are to be found in many substances, but only in microscopic form. Swedish iron contains a small quantity of this valuable material. The presence of vanadium in steels has a tendency to add longer life, strength, and durability. It is easily welded, it is superior in rigidity, and extremely easy to machine. Its elastic limit under all conditions is extremely high as compared with the tensile strength, for use in gears, frames, axles, crankshafts, and propelling shafts. Vanadium steel is considered to be more serviceable than any other metal known.

Specifications for the treatment of metals for A. L. A. M. screw material, cylinder iron, steel castings, and nickel castings were issued, with directions for obtaining the maximum results in their use.

The visit of the members of the Mechanical Branch, in a body, to the Bethlehem Steel Works, as the latter's guests, was accompanied by some interesting results. The Branch spent the entire day minutely inspecting the methods employed by the Bethlehem Steel Company in the manufacture of special grades of steel. The willingness of the large steel companies to co-operate with the Association in the manufacture of the highest grade of material is, in a measure, responsible for the superior grade of steel found in the licensed cars.

Thorough investigation by the test committee brought out the fact that not only was there considerable variance between the practice of various manufacturers in the use of taps and drills, but even the screw manufacturers were at variance in their own establishments. A standard drill size was suggested and adopted by the members of the Branch and the outside makers of drills and taps. The adoption of a uniform magneto base was thoroughly recommended, especially when it is known that many new magnetos are to be placed on the market. The tendency of the makers for their 1908 models will be the use of magnetos. These will have a standard base, so that option on magnetos can be given without reconstruction of base standards.

A new department of the Branch which will be a source of benefit to each engineer, and in fact to the whole engineering world, will be the Mechanical Branch Technical Library, under the directorship of Coker F. Clarkson, secretary. The library, to be formed at the Association rooms, will consist of not only all the necessary books and papers on engineering subjects of pertinent interest, but an accumulative indexed library will be kept on all topical engineering subjects. Results of all experiments and researches in metals, oils, tires, fuels, etc., will be digested and put in concrete form for distribution to the members of the Licensed Association. Experiments, tests, and formulæ emanating from the Association laboratory at Hartford and from the laboratories of all the licensed members will be chronologically and specifically tabulated. A digest of popular and scientific subjects appearing in current periodicals will be made, and metallurgical information collected from all steel manufacturers and producers. In this way the practical knowledge of the manufacturer and the theoretical research work of the scientist are made available.

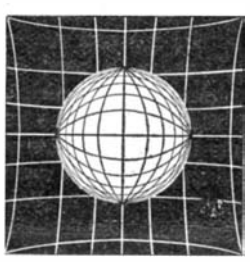
AN OPTICAL ILLUSION.

BY GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

In a stereoscopic view two photographs, taken from two points not very far distant from one another, give the effect of relief when viewed through the instrument. It is commonly believed that this fact proves the necessity of binocular vision to obtain a relief effect. The following experiment shows that the same perception can be had with the use of one eye only and with a flat drawing, if the eye is deceived by some artifice which it is not educated to recognize as such.

Take a piece of pasteboard, and with a pin make a hole in it. Bring the pinhole quite close to the eye, and through it look at the accompanying figure. The figure should be in full light, and at a distance from the pinhole not over one inch. Under ordinary circumstances, every line would be blurred with the figure so uncomfortably near the eye; but the pinhole acts as a diaphragm, which decreases several of the defects of a short-focus lens, and the figure will remain distinct—not only distinct, but also changed in appearance. The central white disk will seem to bulge out of the black field as if it were a convex hemisphere. The perception of relief in that case is immediate, and as strong as it could be obtained with the stereoscope.

The illusion is partly the result of the abnormal curvature of the focal surface, the crystalline lens of the eye acting as a very short-focus lens in such a case. The lines drawn on the white disk and on the black field help to deceive the eye. Their crowding together near the edges of the disk causes them to resemble great circles drawn upon a sphere. Moreover, the eye is not free from distortion. If a few parallel lines running close together are looked at through a pinhole at a very small distance, they appear as if they were bent inward on the margin of the image. On the white disk the lines have been curved the way distortion would bend straight lines if they were brought close to the eye. On the black field white lines have been drawn so as to appear nearly straight in spite of the barrel-shaped distortion, which is the result of the position of the diaphragm before the eye when the crystalline lens assumes its greater convexity. The fact that the lines on the disk seem to be strongly distorted, while those on the field do not, probably causes the eye to underestimate the distance of the disk and to overestimate that of the field.



A Diagram With Which an Interesting Optical Illusion Can Be Obtained.

At any rate, the illusion is much less striking if the lines be omitted.

And if it be made with a black disk on a white field, every other feature of the experiment remaining unchanged, it again becomes evident that the effect of relief is not so easily perceived. Irradiation, which causes a luminous object to appear larger and nearer than a dark one, has a share in the production of the illusion.

A TWENTIETH CENTURY CAMPANILE.

With the purchase of the plot of ground fronting on Madison Square upon which the church of Dr. Parkhurst was for so many years a familiar landmark, the Metropolitan Life Insurance Company secured the remaining plot of ground of the whole block between Fourth and Madison Avenues and 23d and 24th Streets upon which the stupendous marble edifice of their home office building is located. The present building, which is ten stories in height, has a frontage of 200 feet by 425 feet.

The northwest corner of the block, recently acquired, is now being prepared for the foundations of a stupendous steel and marble tower which, on a base measuring 75 feet by 85 feet, will soar to a maximum height of 658 feet above the sidewalk and 690½ feet above its foundations. The main office building is in the pure early Italian Renaissance style, and its Tuckahoe marble, in the few years since its erection, has commenced to mellow down to a pleasing soft buff tone in color. The style and masonry of the main building will be preserved throughout the tower in the general designs and details, and the tower itself will be of the type of the famous Italian campanile which is such a marked feature of the Renaissance period.

As will be seen from our front-page engraving, this twentieth-century campanile will be chaste and severe in design, and of a grace and dignity of outline suitable to its stupendous proportions. As far as the fourth story the tower will conform in line and detail to the four lower stories of the main building. Above this the shaft of the tower will be simple and severe, consisting of three groups of triple windows on each side, with heavily molded and deeply recessed jambs. This method of treatment will be carried up throughout twenty-one stories with nothing to break its uniformity except a course of projecting marble balconies at the level of the main cornice of the main building. These balconies are intended to have the effect of carrying the strong line of shadow of the main cornice around the tower without breaking in upon the unbroken upward sweep of the piers and heavily rusticated angles of the tower. From the twenty-first to the twenty-third story at the height of 324 feet above the sidewalk, will be a great clock, the hands of whose four dials, one on each front of the tower, will be 12 feet in length, with figures 4 feet long, the diameter of the dial being 25 feet, 6 inches.

As a capping to the shaft there will be a line of projecting and paneled balconies, then a series of deeply-incased Ionic loggias with five arched openings on each face of the tower. Above these will be a deep frieze, a cornice, and a parapet balcony. Inside the balcony the walls of the tower will be offset to the extent of 8 feet inward from the face of the shaft. The offset section will be carried up for four stories and will form the base for a pyramidal termination, the sloping face of which will be covered not with copper, but with the same blue-white marble as the shaft. Above this will be an octagonal colonnaded observatory extending to a height of 658 feet above the sidewalk.

There can be little doubt that this stupendous marble shaft, when completed, will be an object of decided architectural grandeur and beauty. Its heavenward lift is such that full one-half of its bulk will rise absolutely clear even of the cornice line of New York city's loftiest building; and long before the traveler is within sight of the city itself he will be able to recognize the blue-white form of the tower in the far distance. So tall will it be that, even after the sun has set and the shadows of evening have fallen upon the streets below, the summit of the tower will be crimsoned with the rays of the sun that has already set behind the distant Orange Mountains. For it is a fact that the highest point of the tower will overtop the highest point of the Montclair hills, which, according to the Geological Survey map, is lower than the Metropolitan tower by about 30 feet.

The view from the upper floors will be simply superb. The most lofty rentable offices will be those of the forty-first story, whose floor will be 526 feet above the sidewalk. From this elevation Manhattan Island will resolve itself into its streets, blocks, and individual buildings with the distinctness and detail of a map. Indeed, practically the whole of Greater New York will, on a clear day, be discernible in the separate details of its topography, and the leading features of its streets and buildings. Those who have visited the Washington monument will understand how great will be the elevation of these office floors, when it is stated that the windows of the forty-first story will be at the same elevation as the lookout windows at the top of the monument.

The story of the dimensions and weights of the structure necessarily runs into large figures. Thus, there will be in the tower no less than forty-six stories above the sidewalk, and in the tower and the main building together there will be a total floor space of twenty-five acres. The steel framework will weigh about 8,100 tons. The weight of the steel work, masonry, etc., combined, will be 38,022 tons; the estimated live load when the building is occupied will be 5,591 tons, making a total weight of the whole building of 43,613 tons.

In designing a tower of this magnitude the stresses due to wind pressure reach a very high figure, and call for a large increase in the section of the columns, etc., to resist them. Thus, in the principal columns on the leeward side of the building, while the pressure due to the dead and live load combined is 7,500,000 pounds, the added load, due to the wind pressure, brings the total up to 10,400,000 pounds, while similarly the corresponding column on the windward side is relieved of pressure, the maximum load during maximum wind pressure being reduced from 7,500,000 to 4,600,000 pounds. From these figures it will be evident that even under the maximum wind pressure, such as would occur in a heavy westerly gale, there will never be any tendency on the part of the building to lift the columns on the windward side from their foundation. This great stability is due to the wider base and more massive construction of this tower as compared with the Singer tower, in which the foot of each column has to be anchored down to the heavy concrete caisson upon which it stands. The skeleton frame of the building is stiffened against distortion by means of heavy knee braces at every intersection of the vertical posts and horizontal floor beams, and the resulting bending stresses in the floor beams render it necessary to greatly increase their section. It can well be understood that the lower sections of the columns are of great size and weight, the large corner columns having a cross-sectional area of 540 square inches of metal. They are built of twelve 8 x 8 x 1 inch angles combined with heavy web and cover plates, the whole post weighing about one ton per linear foot. For the information upon which this article is based, we are indebted to Messrs. N. Le Brun & Sons, the architects, and Messrs. Purdy & Henderson, the consulting structural engineers.

Correspondence.

A Musical Problem Solved by the Telharmonium.

To the Editor of the SCIENTIFIC AMERICAN:

There is a feature of Dr. Cahill's invention, the telharmonium, described in the SCIENTIFIC AMERICAN of March 9, which seems to have been overlooked, namely, the fact that it presents the possibility of solving a problem which has baffled musicians ever since the invention of keyed instruments.

I refer to the problem of constructing a musical instrument that will use the natural or perfect musical intervals in all scales.

As is well known, a scale founded on the key of C, and having proper intervals or vibration ratios for that key, does not contain the proper notes for the key of D, and the deviation is still greater for other keys. To provide correct intervals for all of the twelve keys would require the use of fifty-three notes in the octave, an entirely unmanageable number. To obviate this difficulty musicians have devised the "equal temperament," in which all of the intervals are, to a certain extent, incorrect, but in which each key is equally favored. To the untrained ear, these discrepancies are unnoticeable, but the musician hears a wavering of the tone which is disagreeable.

Many devices have been proposed for the purpose of making this small change in the vibration numbers as the music progresses from key to key, but none has been successful. Dr. Cahill's invention, however, makes the accomplishment of this comparatively simple.

Since the inductors giving the fundamental and all overtones of the same note are all mounted on the same shaft, it would only be necessary to make a small change in the rate of revolution of each of the twelve shafts (corresponding to the twelve notes of each octave) to accomplish the correct tuning for any particular key. While the performer was playing in one key the instrument could be tuned for that key, and as the music progressed to a new key a gear-changing device could be brought into action which would tune the instrument for the new key. Thus, correct intervals could be used for all keys and the dream of musical constructors would be an accomplished fact.

The objection that will probably be cited against this method is that the capacities and inductances are arranged to respond to one vibration period, and one only, and that this will not permit any variation. In answer to this, I will say that the change in the speed of the shafts will in no case exceed one per cent, and, since the curve of maximum current for given capacity and inductance is not a sharply peaked one when there is resistance in the circuit, the small change suggested will not interfere with the working of the transformers. WILLIAM C. WOODLAND.

Warren, O., March 9, 1907.

The Meteorological Conditions Above St. Louis.

To the Editor of the SCIENTIFIC AMERICAN:

While I might hesitate to claim credit again in your columns for another investigation of my own, the fact that its execution was aided by the Louisiana Purchase Exposition and by the Smithsonian Institution leads me to correct a statement which appeared in your issue of January 19, 1907, page 74, under the title "International Aeronautic Contest of 1907."

The data relating to the wind at high altitudes above St. Louis, which you attribute to the government Weather Bureau, were in reality obtained by my assistants, Messrs. Clayton and Fergusson, during the closing months of the World's Fair, in the winter and summer of 1905 and in the spring of 1906. As I announced in your issue of August 6, 1904, the co-operation of the St. Louis Exposition would enable me to obtain the first observations in America at great heights in the free air with balloons carrying self-recording instruments, which, on account of the proximity of Blue Hill to the ocean, could not be employed here. After rising quickly to a great altitude these small rubber balloons filled with hydrogen gas burst, and parachutes bear the instruments gently to the ground, where they are usually found. Fifty-six of these balloons were sent up by us from St. Louis during the years 1904, 1905, and 1906, and, by remarkable good fortune, fifty-three were found and were returned to this observatory on payment of a small reward to the finders. Upon a revolving clock-drum coated with lampblack, continuous records are made of barometric pressure (from which the height is obtained) and of temperature, and, from the automatically recorded times of the ascent of the balloon from St. Louis and the descent at a known place, sometimes several hundred miles from the starting point, the direction and velocity of the drift can be calculated. You have summarized roughly the data which I obtained when you say that the usual wind prevailing in the upper altitudes proceeds in an easterly direction from St. Louis toward New York.

Classifying all the ascensions made during the different seasons according to altitude, I have calculated the average drift of the air-currents at various heights in the vicinity of St. Louis, which, in view of the selection of that place as the starting point of the international race for the Gordon Bennett cup next October, seems to warrant publication here in some detail. Eight balloons, at an average height of 6,000 feet, moved from an average direction of 11 deg. north of west at an average speed of 25 miles per hour; thirteen balloons traveled at a height of 12,000 feet from 3 deg. north of west at 38 miles per hour; sixteen balloons, at a height of about 20,000 feet, moved from 5 deg. north of west at a speed of 56 miles per hour; and nine balloons, moving in the stratum 26,000 feet high, went from 9 deg. north of west at a speed of 47 miles per hour. These conclusions are confirmed by the numerous measurements of the drift of clouds which have been made at Blue Hill. Since the racing balloons probably will not exceed a mile in altitude, they are likely to travel toward some point slightly south of east at a speed of about 25 miles per hour. Although at the altitude of a mile or two in the month of October it will be only moderately cold, at the great heights reached by our sounding balloons extremely low temperatures prevail. Even in July, 1905, the temperature was 75 deg. Fah. below zero at a height of 45,000 feet, while in the preceding January, during the prevalence of cold weather at the ground, a temperature of 111 deg. below zero was recorded at a height of 48,700 feet. The latter temperature is one of the lowest temperatures if not absolutely the lowest natural temperature yet recorded either on the earth or in the atmosphere.

The balloon furnishing this record moved with great speed and landed in northeastern Mississippi, 285 miles south-southeast of St. Louis. Two other balloons, which were dispatched on successive days in November, 1904, after rising to heights of 37,700 and 35,400 feet, respectively, landed, the first in Kentucky, 280 miles east, and the second in Tennessee, 235 miles south-southeast of St. Louis, both having traveled at the rate of one hundred miles an hour. As this represents their average velocity in the lower and upper air strata, it is probable that the highest currents moved considerably faster than one hundred miles per hour on these days.

A. LAWRENCE ROTCH,
Director of Blue Hill Meteorological Observatory,
Hyde Park, Mass., March 19, 1907.

The Gila Monster Again.

To the Editor of the SCIENTIFIC AMERICAN:

In a recent number of your periodical was an article on the "Gila Monster," in which was an account of two cases of bites by the lizard which happened in Arizona. Being perfectly familiar with the entire history of the cases cited as evidence of the poisonous characteristics of the reptile, I write to correct the narrator in a few minor details as well as to discuss the venomous nature of the bite.

The first case mentioned did not occur in Tombstone, Ariz., but in either Fairbanks or Contention (two small towns then existing about ten miles from Tombstone), the former, I think. The man was bitten and died, and I was one of the physicians summoned to attend him. The autopsy demonstrated cirrhosis of the liver, ascites, fatty heart, etc., and his history evidenced the cause of his death to be acute alcoholic poisoning grafted upon chronic alcoholism.

In the second case, that of Mr. Vail, the circumstances surrounding the accident were as related. Mr. Vail, believing as did most of us at that time that the lizard was a venomous reptile, followed the usual frontier methods of treatment—ligation of the finger with large quantities of alcohol internally; and his physician, Dr. Handy, after his arrival cauterized the wound, making an excessively sore finger for some time, but the finger neither was paralyzed nor withered nor useless afterward; and just prior to his death, which occurred a few weeks ago as the result of a street-car accident in Los Angeles, he had as free use of the finger as he ever had, and I saw him the day preceding his accident.

In December, 1891, the writer, who was then engaged in studying the Gila monster and other alleged venomous reptiles and insects, had in his collection a dozen or more "monsters," and while handling one of them was seized by the left index finger just back of the nail, and a severe bite inflicted. No crowbar, knife, or hatchet was required to disengage the enraged animal, which hung on viciously; merely a strong pull with pressure of the jaws liberated the digit, which was treated simply, and aside from the usual soreness accompanying a lacerated wound of the pulp of the finger involving the nail, no inconvenience was experienced, nor was the writer prevented from following his usual professional work, except—naturally—the surgical side of it. No constitutional symptoms whatever supervened. At that time, owing to the investigations which he had been making for some months, he had arrived at the conclusion that the belief in the poisonous nature of the lizard was purely mythical and superstitious, the remnant of primeval man's antagonism to all creeping things.

In addition to the three cases mentioned, I have known quite a number of people who have been bitten by the lizard either on the foot or the hand, but in no instance has death been the result. If the usual folk treatment of ligation of the wounded part with alcohol internally was followed by cauterization of the wound, general *malaise* with a more or less sore member has succeeded, but not death.

The Gila monster, of which there are two species on the deserts of the Southwest, has neither poison glands nor fangs. Its teeth(?) are not hollow, consequently nowhere within the jurisdiction of its mouth is there the wherewithal to envenom a wound made by them, and this assertion is based upon numerous dissections and anatomical investigations. If much irritated it does eject the contents of its stomach, which are more or less fetid, while hanging to an object it has been exasperated into biting. This may or may not be accidental, for it does not always occur; only after swinging or shaking severely the reptile while still attached to the object bitten. That neither knife, chisel, hatchet, nor crowbar is needed to release an object from the grip of its jaws, simple inspection of the anatomical structure of its head will suffice to demonstrate. The grip is a firm one, but one released by an unterrified person with comparative ease.

About this same time (1891) exhaustive studies were made by some of the attaches of the Smithsonian Institution, among whom was Dr. R. W. Shufeldt, concerning the nature of the animal, and conclusions reached which the writer had previously attained—that the reptile was non-venomous; and it may be accepted as conclusively demonstrated that the bite of the "monster" is innocuous *per se*.

GEORGE GOODFELLOW.
1059 O'Farrell Street, San Francisco, Cal.

Sugar Statistics.

The consumption of sugar in the United States is increasing rapidly, more rapidly than is the production. During the year just ended we used the enormous amount of 6,500,000,000 pounds of sugar, worth $300,000,000. If each citizen got his fair share, during the twelve months he consumed 76 pounds. Of this sugar only one-fifth was produced in the United States; one-fifth came from the island possessions, and three-fifths was imported from foreign countries. Of the American-produced sugar, a little over half was from the sugar-beet, the remainder from cane. This is the first time the beet-sugar has exceeded in quantity that manufactured from sugar cane. During the last ten years the increase in the consumption of sugar has been three times as great as the increased domestic production.

The Current Supplement.

"The Buried City of Ceylon" is the title of the opening article of the current SUPPLEMENT, No. 1630. Comparatively few people realize that on that island was once a civilization which, when Christianity was born, was at its height. A glimpse of that marvelous civilization is given in the article in question. The fight against yellow fever is discussed by A. Dastre. E. T. Lake writes on pattern making or molding of cylinders for two-cycle internal-combustion engines. Charles B. Steinmetz thoroughly discusses light and illumination. Baron Suyematsu writes on the ethics of Japan. Coming as it does from a well-known Japanese, this article is most authoritative. Waldemar Lindgren contributes a paper on gold and silver production in the United States. The commercial graphophone, which has been lately introduced to supplant the stenographer, has been so far improved that it meets the requirements of the business man. It is possible to expunge matter which the dictator wishes to cancel and to substitute matter for it. A signaling device is also used to indicate when the end of a blank has been reached. A special form of recorder and reproducing stylus completes the improvement. A full description of this instrument with illustrations is published. Single-phase vs. three-phase power transmission is the subject upon which Ernest Van Loben Sels writes. Emile Guarini presents a description of the Ella system of wireless telegraphy. The mutation theory of the origin of species is criticised by A. E. Ortmann.

The newest innovation that has taken place in the method of working a coal mine is the substitution of concrete for the mine timbering. The experiments along this line are being made by the Reading Coal Company at Shamokin, Pa. A plant for the manufacture of these cement props will be erected at the North Franklin colliery, Trevorton, from which place the new style of "timbering" will be sent to all the other collieries. The Reading Company has spent considerable time and money in determining the best method for preserving mine timbers, and the present step seems to indicate that in the future cement will replace wooden props.

EXCAVATIONS AT NAGA-ED-DER, WHERE PREHISTORIC MAN FIRST SETTLED IN EGYPT.

BY ENOS BROWN.

The University of California has received the final report of Dr. J. C. Reisner, who has been employed for six years in prosecuting a series of excavations under its auspices, and gathering together a collection of antiquities for a museum it proposes to establish at no distant day. Dr. Reisner excavated at several different sites, and the fruits of his labors are now being received. Hundreds of cases are being unpacked and their contents catalogued. They embrace an enormous number of objects, demonstrating the gradual progress of the arts from the earliest or Paleolithic age, the age of flint, through the period of its highest development in the Cheops dynasty, up to the time when Egypt sank to the position of a Roman dependency. The rise of civilization, from a period antedating the Christian era by 7,000 years, can be unerringly traced in the flints, pottery, carvings, statues, and inscriptions, found in ancient cemeteries or sites of cities, ransacked to enrich the museum of an American university and to benefit the scholars of the new world.

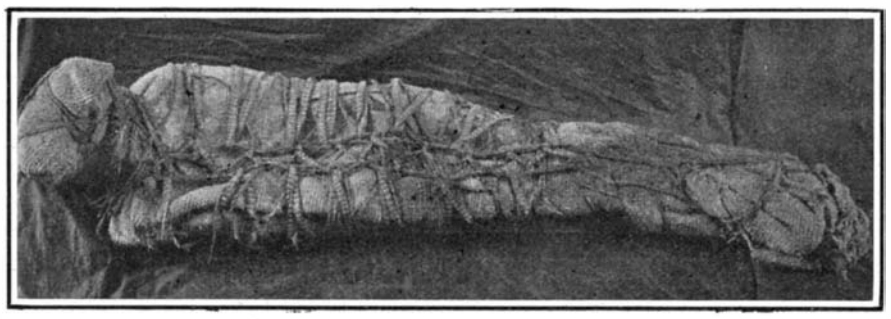
Of all the discoveries of the explorer, none surpasses in scientific interest or importance those from the prehistoric cemeteries of Naga-ed-Der, where it is believed the first settlement of man in Egypt occurred. This site, never before explored, is located about 300 miles southeast of Cairo, on the edge of the eastern desert, and, at the time of its first settlement, the country round about was not the barren waste it now is, but was fertile, with an abundant rainfall, and capable of supporting a numerous population. Ninety centuries ago Egypt was not dependent upon the Nile for moisture. In this interval deposits of the river have amounted to 25 or 30 feet and, allowing four inches deposit for each century, the time for beginning, as well as the period when the climate of the country began to change, is calculated. Naga-ed-Der was a settlement long before its site was transformed into a desert.

It is generally admitted that Egypt was settled first by people of Asiatic origin, and confirmation of this theory has been discovered in the graves of Naga-ed-Der, in which many skeletons of the earliest period were found. These were fortunately in perfect condition, and afford splendid anatomical material for determining the racial character of the prehistoric people, which, ethnologists conclude, was Asiatic and not Nubian. Even the contents of the intestines were so well preserved that it was possible to determine, not only the food, but even the medicines which were contained in them. The disease from which the person died could be easily diagnosed. Many were resurrected who died of some kidney complaint, others of gall stones, and others of diseased bones.

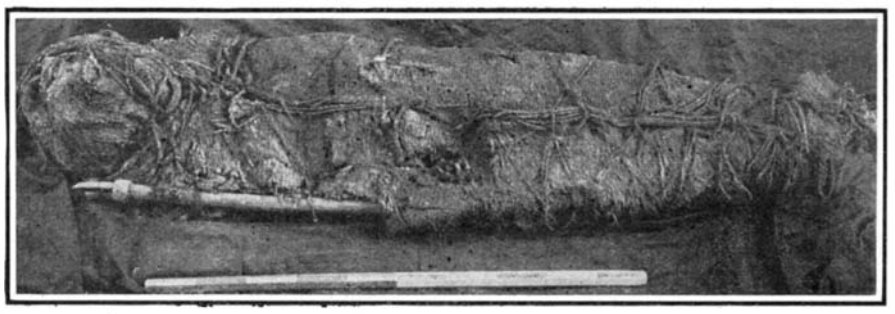
The remarkable fact that the people now living over the site of the prehistoric cemeteries are racially identical with those who inhabited the country 9,000 years ago was established beyond a doubt. In every physical peculiarity there had been no change during this long interval. The graves also afforded much information as to the customs, habits, and progress of this primitive race, with types of burials, graves, food-stuffs, hair dressing, and pottery. The development of an instinct for art was indicated by rude figures, with which they adorned the pottery fashioned. Their weapons were carved of flint, sometimes in the shape of snakes' heads and animals. No objects of metal were found, and the conclusion is they knew nothing of metallic substances. Copper, the first metal known in Egypt, was introduced probably about a thousand years later by the race which conquered the country and is supposed to have come from the north of Africa. The burial customs at Naga-ed-Der indicated a regard for the preservation of the body, which Egyptians in later periods carried to remarkable lengths. The prehistoric mummies were preserved in salt, and in the grave were carefully incased in matting made from halfa grass, formed of reeds woven together with the fiber of the same plant. Votive offerings consisting of flints or pottery or both were always interred with bodies. The tenacity with which ancient customs survive is shown by the use of halfa grass, of which the prehistoric people wove mats, made in the most primitive manner, and every other generation since, to the present day, has imitated. The graves were excavated in either elliptical or rectangular shape, a layer of one or more mats being placed upon the bottom on which the body reposed.

All the bodies found were in the same position, the knees supporting the chin and resting upon the side. Over the body was laid another layer of mats when the grave was filled. Some were found in which a sort of coffin of wood was around the body, large enough to contain the funerary offerings and pottery which seem to have been a necessary accompaniment of every burial. Beads, combs, and armlets of primitive workmanship were found in the graves of women.

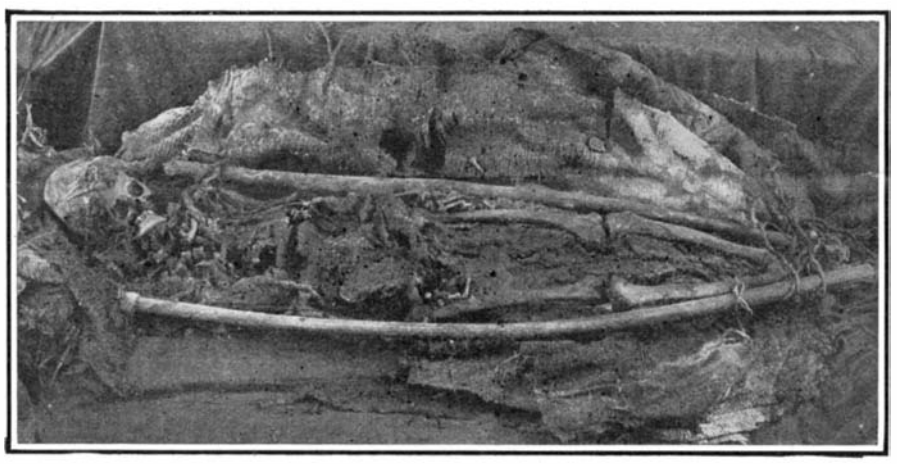
The site of Naga-ed-Der seems to have been consecrated to burials, for the dead of every period are to be found there. The Copts have had their own cemeteries here ever since the Christian religion was introduced into the country, and use them for interment at the present day. These old Coptic graves afforded valuable results to the explorers, and much light upon the customs, habits, and manners of this interesting people was secured. Coins, minted in the time of Justinian, were found with vast quantities of beads, necklaces, bracelets, earrings, and finger rings, crowns, pendants with crosses and other emblems of the Christion religion made of bronze, sometimes gilded. Amulets of old Egyptian manufacture upon which the cross had been engraved were numerous. The Copts mummified their dead, and most valuable results followed the unwrapping of many of them, as persons were interred in great state, with all their choicest possessions and most elaborate decorations. Beautiful jewelry, embroideries in rosettes, flowers, geometrical designs, cupids, men and women, and executed with skill, rewarded the explorers, and opened a field of investigation rich beyond anticipation.



THE FIRST STAGE.

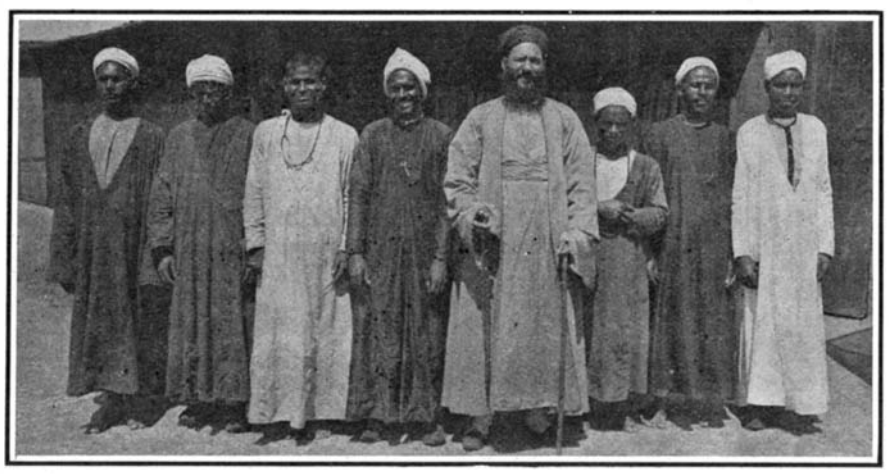


THE SECOND STAGE.



THE THIRD STAGE.

The Three Stages of Unwrapping a Coptic Mummy.



Group of Workmen of the Rifai Sect with Their Religious Sheikh (Sheikh Hasan).

EXCAVATIONS AT NAGA-ED-DER, WHERE PREHISTORIC MAN FIRST SETTLED IN EGYPT.

The Story of Malaria.

BY L. H. YATES.

The Story of Malaria, as told by Major Ronald Ross, F.R.S., first to an audience of the Royal Colonial Institute of Great Britain, and later in the pages of the National Review, is full of most interesting facts that are apt to pass the memory, unless recalled from time to time. Our present knowledge, as he reminds us, is the result of more than two thousand years of patient study, and it forms what might be called a gigantic epic of science. It tells of a long and hard-fought battle between man and nature, and it is only to-day that we even begin to see the promise of victory.

If we go back to the writings of Hippocrates and his successors, some 400 years B. C., we learn that the Greeks and Romans were then studying the character of malaria, and had distinguished its class by two important points; the first was that malarial fevers are not continuous in type, but occur in periodical attacks, and these attacks they classified as quotidian, tertian, and quartan; that is, occuring every day, every alternate day, and every third day. Although we now understand that attacks may, by overlapping, present the appearance of a continuous fever, this does not contradict the ancient classification. The second point found out by them, and attested by succeeding experience, is that there is direct connection between marshes and swampy pools or soil and the prevalence of this kind of disease. They even went so far as to point to a probability of the disease being disseminated by a species of germ or microbe to living man, thus approaching remarkably near to our nineteenth century "discoveries"! Indeed, we seem not to have disproved any of the theories of the ancients, but rather to have enlarged upon them, added to their number, and established their certainty. After the ancients—a very long time afterward—the next step forward was taken in South America. To a villager of Malacotos, in Ecuador, we owe the discovery of the efficiency of Peruvian bark as a cure for malarial fever—or as we should more correctly term it, an antidote. This became known in Europe about 1640, and acquired fame after it had been used to alleviate the agues of Louis XIV. In 1820 two French chemists separated from Peruvian bark its essential alkaloid, quinine. Still, after the lapse of two and a half centuries, the bark or its alkaloid are the accepted specifics against malarial fevers. By experimenting with the use of these drugs, it was found possible to separate with greater precision the different types of fever and determine the periods of attack.

To the story of malaria another chapter was soon after this contributed by British military and naval surgeons, at a time when British ships were exploiting all waters. These found malarial fever to be common in all tropical and sub-tropical countries —that it was an enemy likely to be encountered almost anywhere. They added their affirmation to the theory that soil as well as water held the fever poison. About the middle of last century, however, when biology became a favorite study and the microscope a more perfected instrument, the granules of what is now called *malarial pigment* were found in the blood, and these pigment granules were found to be the refuse matter of innumerable little parasites, which, living within the blood, caused disease. Almost at the same time that this discovery was made, Pasteur, Koch, Lister, and others were discovering that bacteria were the cause of anthrax, tuberculosis, cholera, typhoid, and leprosy. The two great discoveries mark together an epoch in history. The essential difference between them, briefly stated, is that malarial germs are protozoa, or the lowest form

of *animal* life, while the bacteria represent the lowest form of *vegetable* life. By close study of the processes followed by the parasites of malaria, it was found that their capacity to reproduce themselves was almost unending, but that it kept to the order of successive generations; and just as all the stalks of corn in a field which was sown at one time reach maturity together, so do the members of the same generation of malaria parasites. The shell of the blood corpuscle which has held the growing parasite bursts when it reaches maturity, and allows its spores to fall into the fluid of the blood, and these again fasten themselves on other corpuscles and begin to germinate in their turn. Millions of parasites will liberate their spores at the same time, and it will be precisely at this time that the patient will be attacked with the ague fit, followed by fever. As some of the spores take 72 hours to reach full development, the next attack of fever will not take place until the third day; as another type develops within 48 hours, the attacks occur every other day; and those which sporulate every 24 hours produce the quotidian fever. It is possible, though perhaps not usual, for one patient to harbor all three varieties at one and the same time.

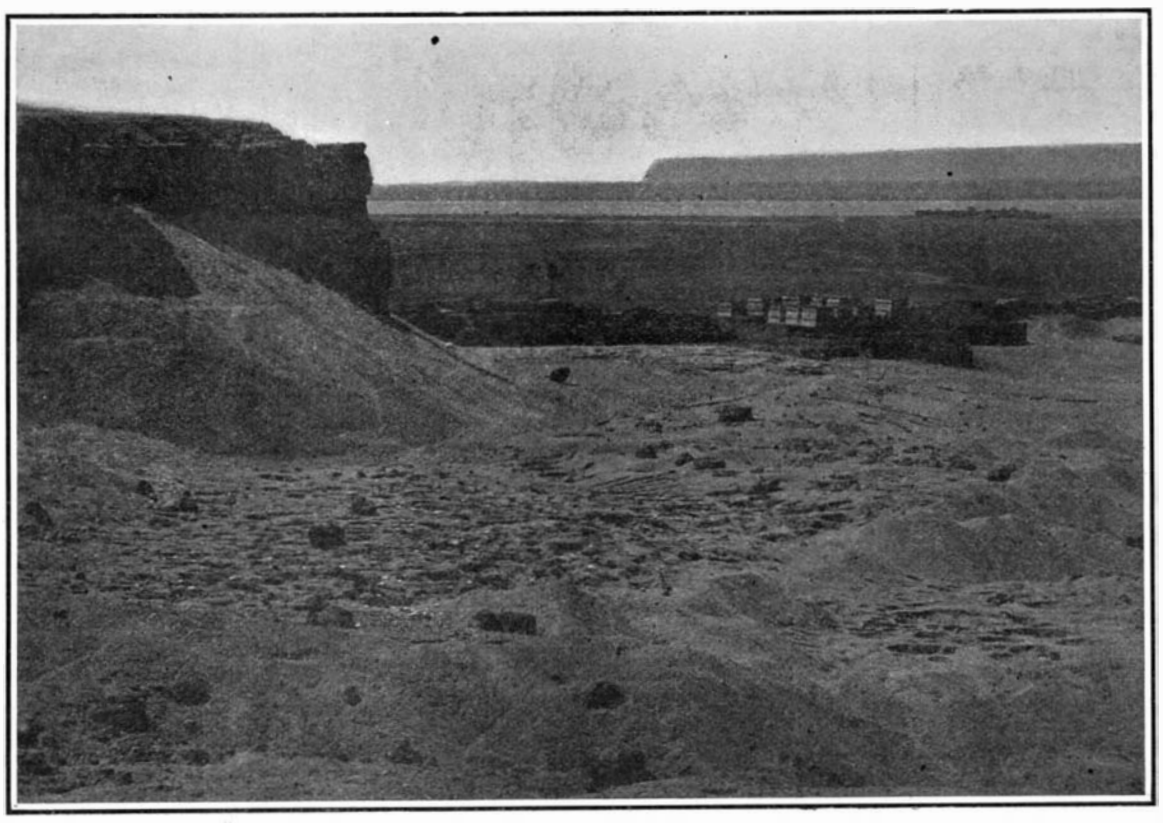
At the time that the malarial parasites scatter their spores in the blood, the patient is seized with chill, nausea, shivering, and fever; very soon, however, the wonderful antitoxic mechanism of the body begins to assert itself, the poison is acted upon, neutralized, and in a large measure eliminated by the sweating which ensues, and the patient is relieved. But another generation is developing meanwhile, and when it reaches maturity another attack is caused, and not until their power of reproduction is weakened, and finally overcome, will recovery be permanent. Even then, undue fatigue, chill, or great heat may cause a relapse by favoring the parasites and their development. The battle must be incessantly waged between the conflicting parties, poison on the one hand, anti-toxin on the other. A startling discovery, made in quite recent times, is that native children in tropical countries, although apparently healthy, often carry these parasites almost constantly in their blood. As the children reach maturity, if they have not succumbed to the poison before then, this early inoculation seems to procure them immunity as adults, for very few adult natives are subject to malarial fevers in the way that Europeans are. While they are young, however, the disease decimates them in large numbers.

The next chapter in the story of malaria had to reveal where these protozoan parasites live in external nature, and how and by what agency they effect their entrance into the human body. The older theories assumed that stagnant water made a home for them, and that they were inhaled in the mists and vapors which rose from the marsh, and possibly by the drinking of foul water. But experiments made in trying to develop the parasites from stagnant water failed to give the supposed results. Then the mosquito theory, existent and in vogue for some centuries, was revived, and trials which were made, independently of each other, added strength to the belief that infection came from the bites of the insect. In 1894 Major Ross was told by Dr. Manson (now Sir Patrick Manson) of his own theory concerning the ability of parasites to transfer themselves from one species of animal to another, and he commenced to make critical examination for himself. When, after two and a half years of experimenting, he was on the point of giving up in despair, he was startled on examining a new species of mosquito to discover in its tissues the very bodies he was in search of. Before he could obtain formal proof his researches were interfered with by his being ordered to a place where there was little or no malaria. The following year the government of India placed him on special duty for the continuance of his study, and then in a few months he was able to establish his conclusions, which were to the effect that when mosquitoes of a particular species suck the blood of infected men, animals, or birds, they draw in with it the parasites of malaria, and these, living and growing in them, produce spores which find their way down the proboscis into the blood of their next victim, infecting him. Thus the mosquito takes the parasite from one infected person, and after a week or more conveys it into the blood of another, probably quite healthy, individual.

After this discovery had been made public, schools of tropical medicine and societies took it up, books and pamphlets innumerable were written upon the subject, and healthy persons volunteered themselves to be acted upon by the experimentalists, so the new study was prosecuted with all vigor. One of the things it is most curious to note is that the results of all this combined working merely developed and added to the conjectures and theories of the ancients. For example, the mosquitoes which carry human malaria belong to a species called the Anophelines, which breed mostly in terrestrial waters, that is, in marshes, which explains the connection between marshes and malarial fever. But it is not the parasite causing the fever which lives and breeds in the marsh, but the gnat or mosquito which is the carrier of the parasitic poison. Where appropriate marshes exist, these insects abound and infect everyone within their reach by inoculating them with the poison they carry from one to the other. It is argued that mosquitoes also exist and abound where there is no malaria, and this is true, the difference being that they are not Anopheline mosquitoes. Happily for us, the Anopheline is a comparatively rare kind.

The remedy which Major Ross advocates most strongly is the tracking and drainage of waters and swamps which favor the breeding of the malaria type; to carry out sanitation in this way is not merely to get rid of the mosquito itself, but of pests of flies and other insects.

His plans are now being included in all the schemes of tropical sanitation, and with the improvement in land, air, and water, cleanliness and better housing come as a natural result, so that the local authority follows hard upon the heels of the imperial officer, and the efforts of both are fast making habitable for man the long untenanted regions of the globe, giving him, in fine, through the destruction of unwholesome conditions, the gift of a new world.

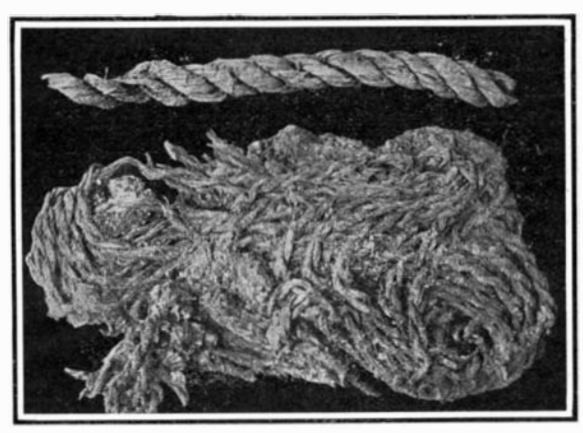


Prehistoric Necropolis.

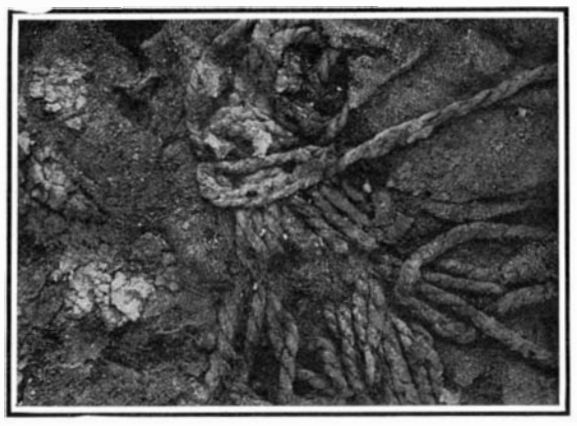
Havana Cigars.

During last year there were exported from Cuba the enormous number of 256,738,029 "Havana" cigars. Contrary to the general idea, however, that America gets the bulk of this trade, only about 30 per cent came here, the total purchases amounting to 79,483,125 cigars, while England took 92,459,687. Germany buys from twenty-five to thirty million, and France ten to twelve million. One reason for the larger sales to England than to the United States is the fact that America buys a large amount of leaf tobacco, which is worked up here; last year twenty-five million pounds were imported, while England took only twenty-five thousand pounds. But few Cuban cigarettes come to this country, most of the manufacture going to South America. Although two hundred and fifty million cigars—the number we received from Cuba—would appear to be a considerable stock, cigar dealers' cases would soon be empty if that were the only source of supply, as America smokes some 8,000,000,000 cigars annually.

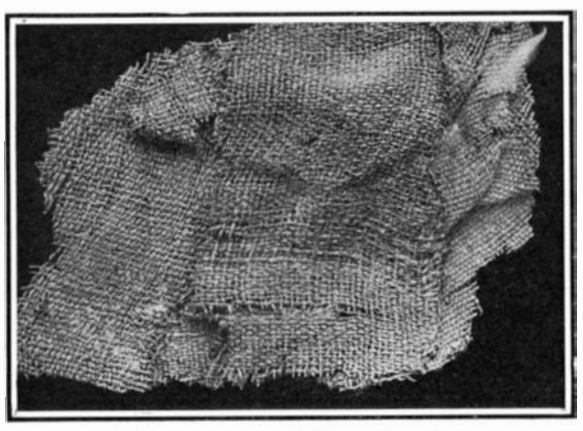
Storing coal in pits capable of being flooded has been adopted at the new plant of an American electric power company at Hawthorne, Ill. A plot about 320 feet by 75 feet has been excavated to a depth of about 12 feet, and lined and sub-divided by concrete walls into twelve 80 feet by 25 feet pits. Their bottom is the clay subsoil, and the walls are carried about 4 feet above ground. The pits can be flooded by means of a 12-inch water main. The longitudinal division walls are wide enough to carry the tracks on which the coal is delivered.



Prehistoric Cord from Clothing.



Prehistoric Ornamental Tassel.



Prehistoric Cloth (Coarse).

Prehistoric Cloth (Fine).

EXCAVATIONS AT NAGA-ED-DER, WHERE PREHISTORIC MAN FIRST SETTLED IN EGYPT.

A NEW HIGH-SPEED PHOTOGRAPHIC SHUTTER.

It is obvious that a "between-lens" shutter which opens from the center outward and closes again in the reverse direction will overexpose some portion of the plate and underexpose others. When the speeds are higher than 1/150 of a second, the imperfect illumination is very apparent. In order to remedy this defect and to render possible exposures of 1/1,000 of a second and less, the focal plane shutter was adopted. As every photographer knows the focal plane shutter consists of a curtain provided with an adjustable slit and mounted to travel in front of and parallel to the plate. By regulating the tension of the springs which drive the curtain, and by adjusting the width of the slit, higher or lower speeds are obtained. Because the plate is exposed by the slit in sections curious distortions in moving objects invariably result, for the reason that during the interval in which the slit travels from one given point to another the object has moved ahead, so that the position of the object relatively to the plate is not sufficiently constant. At its highest speed, the efficiency of the focal plane shutter decreases as the slit is narrowed, because the light rays suffer interference, so that serious speed limitations are imposed. To overcome these defects in illumination, photographers soon began to use lenses of large aperture on very small cameras to allow more distance between the object and the lens and to concentrate a greater amount of light on the plate. Thus it happened that lenses working at apertures of f.5 or even f.3⁶ superseded lens working at f.6⁸ with a consequent sacrifice in definition.

Mr. Gustav Dietz, a New York inventor, has given the problem not a little thought, and seems to have solved it satisfactorily. Abandoning the focal plane principle entirely because of the objections to sectional exposures, he has returned to the "between-lens" shutter and invented a form of blade which permits a brilliant uniform illumination of the plate, and renders it possible to use slower lenses at speeds of 1/2,000 part of a second, with the result that admirable definition is secured without any distortion of the image.

The "multispeed" shutter, as Mr. Dietz calls his invention, is driven by an adjustable spring which is coiled around a spindle carrying at its outer end a bevel gear meshing with the segmental rack of a driving-ring *d*. The driving-ring travels on ball bearings in both directions. Four blades, *c*, are pivoted to this driving ring and are moved with the ring when the tense spring is released. Each blade is centrally slotted to receive a pin, by which its movement is guided in such a manner that the blade is gradually opened, thrown open quickly, and gradually closed again without any side or central strain whatever, having completely turned over and fully exposed the plate. No matter what the speed may be, whether a time exposure of several seconds or a snapshot of 1/2,000 part of a second, the same revolution of the blades occurs. The shutter opening thus attained is peculiar. The lens is opened from the center in an increasing star, and the blades spread full in the middle of the movement, closing again from a different point of the lens-aperture's periphery and thereby exposing the corners of the plate more than the center. Vignetting is consequently impossible even with high speeds, large plates, and wide-angle lenses. Because no diaphragm stops are used to secure an increase of definition as with the focal plane shutter, no light is lost, and yet definition is vastly augmented, and because of the excess circumferential illumination very high speeds are possible even on dull days.

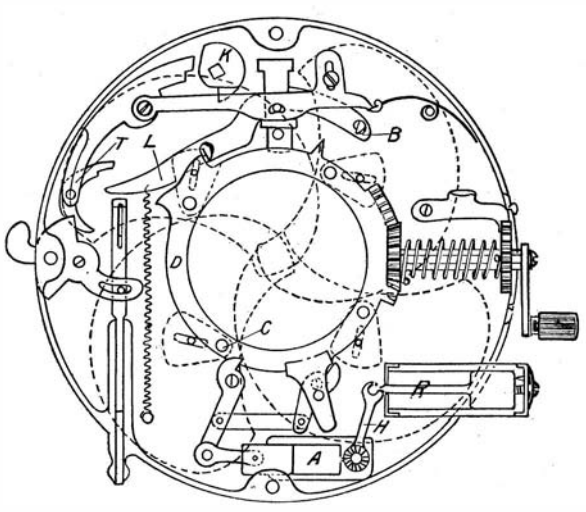
Exposure $\frac{1}{1000}$ seconds; f. 6⁸.

Exposure $\frac{1}{1000}$ seconds; f. 5⁶.

Exposure $\frac{1}{2000}$ seconds; f. 5⁶.

Three Difficult Subjects Taken With the Multispeed Shutter. The Good Definition Should be Noted.

Not the least striking feature of this shutter is its noiselessness. On the higher speeds the blades are arrested without shock by an air-cushion, *A*, which is controlled by the link *H* of the piston *R*. For speeds of 1/200 of a second and less the knob of the retarding piston is connected with the driving ring. Hence the air-cushion is opened at the same time, and the ring and blades move slow or fast according to the tension of the coiled spring. The retarding device simply forces the spring to spend the motive power slowly. It is therefore clear that the higher the tension, the quicker the exposure, which increase is absolutely uniform in ratio to the increased spring tension. For bulb or time exposures, which are set by means of a knob *K*, the ring is stopped half way by a lever *B*, which is brought into engagement with a hook on the ring when the principal release lever *L* is raised. In setting the shutter for time exposures, a lever *T* is employed, which locks the principal release and also the bulb lever and is unlocked by a second action of the release mechanism. Slow, instantaneous, bulb, or time exposures are quite noiseless because of the retarded action of the driving ring. Without this retarded action, bulb and time exposures are quick-acting and clicking. The compound movement of the four blades is kept for instantaneous exposures of several seconds duration on account of the vastly increased definition, which renders objects out of focus only softer, but never indistinct. This should be of special value for portrait and landscape studies, when instead of a sharp-cut effect a uniform softness is desired. Objects quite indistinct on the ground glass are brought back to soft definition again.



The Operative Mechanism of the Multispeed Shutter.

The different speeds are recorded on a ring which is geared to the tension wheel of the spring and travels in a groove around the shutter casing. The release is effected either by hand or by cable.

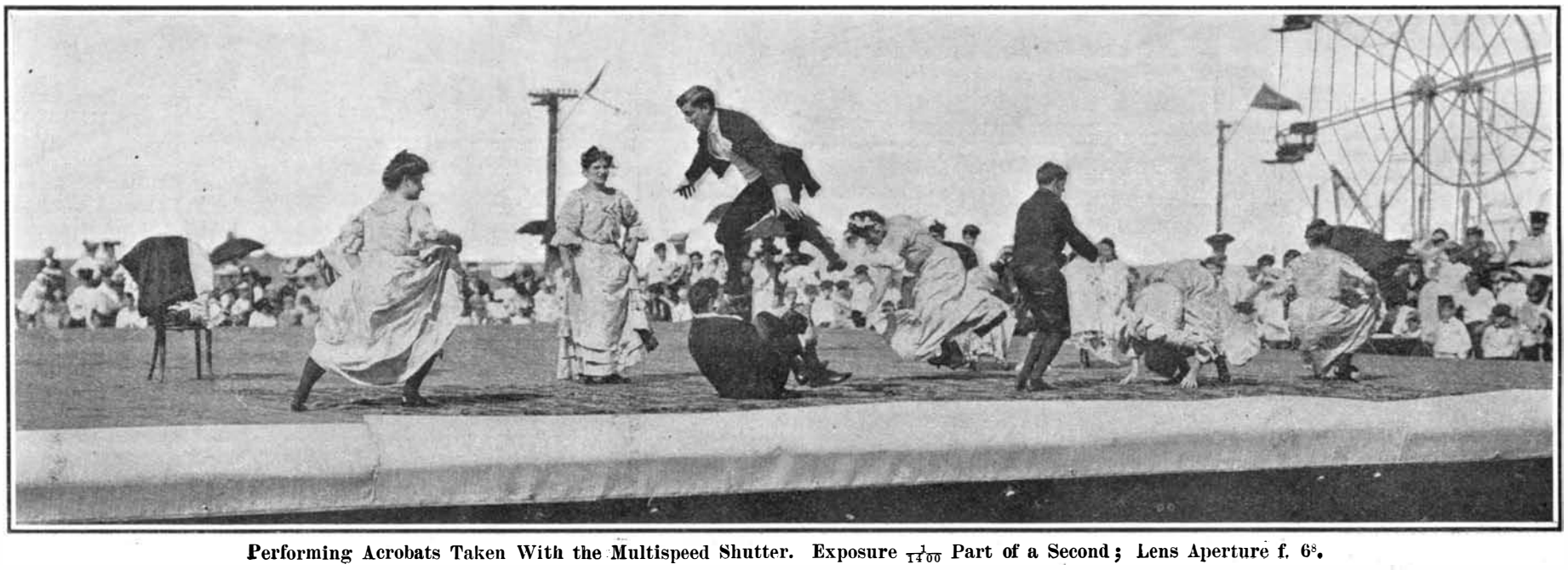
The shutter can be applied to any camera for any class of work.

Wireless Message on Atlantic Coast Received in California.

On Sunday, March 10, A. J. Millison, the operator at the wireless telegraphy station on Point Loma, in southern California, observed his apparatus intercepting a message. On investigation he ascertained that a message was being sent from Washington, D. C., to Pensacola, Fla. He adjusted his instruments, which are the most delicate used by the United States government, and caught the whole message. At about the same time part of a message to the battleship "Connecticut" from Washington was clearly read on the instruments at Point Loma.

Highly gratified, the operator sent messages to the Atlantic coast, and received answers from the operators at Washington and Pensacola. Later he wrote out copies of the messages that he intercepted on the Atlantic coast and sent them, with letters, to the operators there.

The distance from Pensacola to San Diego in an air line is about 1,800 miles, and from Washington to San Diego is about 2,400 miles. The matter has been reported to Commander H. C. Gearing, Chief of the Equipment Department at Mare Island navy yard, California. The messages sent by the operator at Point Loma to Washington were only faintly recorded on the instruments, but the messages between Washington and Florida and part of a message from Washington to the battleship "Connecticut," 600 miles out in the Atlantic Ocean, were recorded clearly. The new apparatus is partly the invention of Mr. Millison, and has been installed in the Point Loma station only a few months. Some time ago the Point Loma operator succeeded in communicating with Tacoma, Wash.



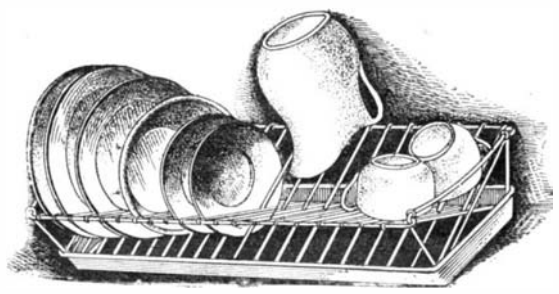
Performing Acrobats Taken With the Multispeed Shutter. Exposure $\frac{1}{1400}$ Part of a Second; Lens Aperture f. 6⁸.

A NEW HIGH-SPEED PHOTOGRAPHIC SHUTTER.

Patent Department

DISH DRAINER.

A novel utensil which should prove very useful in the household has just been invented by Mr. James P. Tibbits, of 509 Mount Hope Place, Tremont, N. Y.

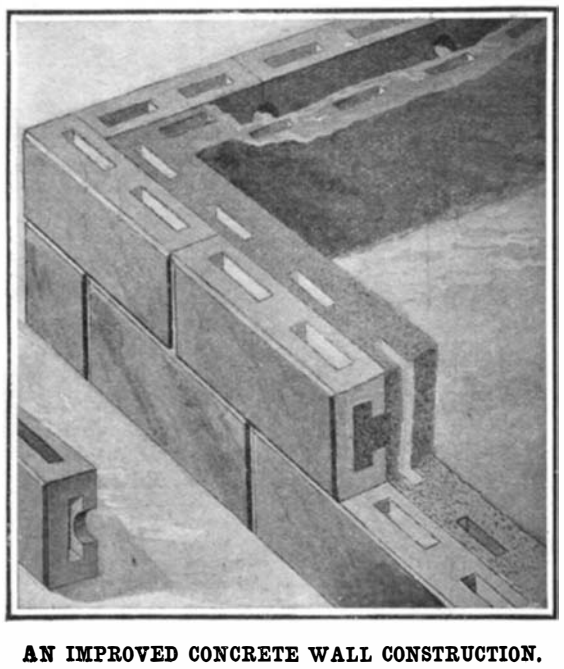


DISH DRAINER.

It is a device for holding plates, saucers, and other dishes in such position as to allow them to drain thoroughly. The utensil comprises a rack in which the dishes are supported and a pan to catch the drip. The rack is formed of two end frames of wire connected at the top and bottom by wire side members. A series of flexible span wires are run diagonally across from each upper side member to the opposite lower member. In order to keep these span wires in place, the side members are bent to a sinuous form. In use the dishes are inserted between the span wires. A considerable number of dishes can thus be accommodated in a comparatively small space. It will be noticed that the span wires touch the dishes at a comparatively small area of contact, and further, that the span wires being of metal, there is nothing to prevent the thorough cleansing of the dishes. Moreover, it will be observed that while each dish is supported at four points of contact, the extreme peripheral edge of each dish is entirely free, so that the drainage is perfect, also that each dish is, by virtue of its own weight, retained in a condition of stable equilibrium and is not easily caused to rock, if the rack be shaken or inclined. If desired, the dishes may be first washed or partially washed before being inserted in the rack, or as some prefer, they may be placed in the rack exactly as they come from the table, and then cleansed by pouring boiling water over them.

AN IMPROVED CONCRETE WALL CONSTRUCTION.

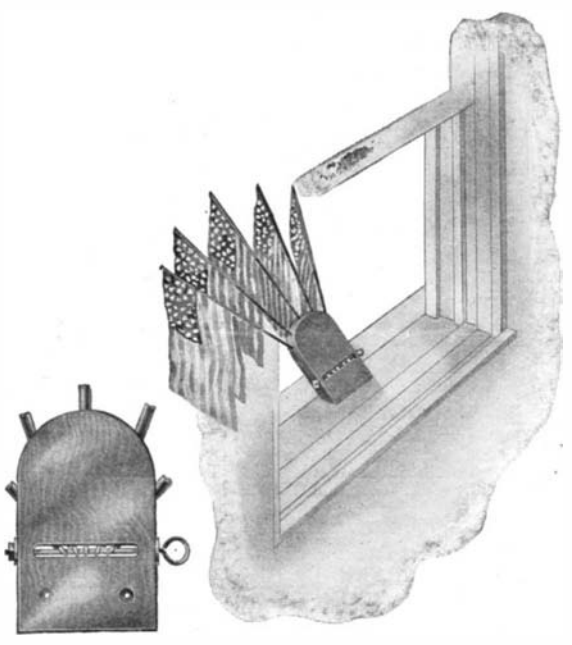
As concrete absorbs moisture as readily as brick, it is obvious that dampness will penetrate a solid concrete wall and appear as beads or sweat on the plastering. For this reason concrete building blocks are formed with air spaces. But this does not entirely remedy the defect, because certain sections of the block which divide the air spaces form a solid mass extending from the outer to the inner side of the block, permitting the moisture to percolate unobstructed to the inner surface. To overcome this, as well as other difficulties generally encountered, Mr. John G. von Hofe, of 122 Elm Street, Long Island City, N. Y., has invented a new type of hollow building block and a new form of wall construction, which we illustrate in the accompanying engraving—a veneer of hollow blocks bonded to an air-spaced monolith mass. The block is narrow, being adapted to be used as an ornamental veneer for a continuous concrete wall. A recess is molded in the end of each block with a semicircular opening in the rear wall, and when two blocks are placed end to end, the adjacent recesses form a chamber, to which access is provided at the rear through a circular port formed by the two adjacent openings. This chamber being larger than the port serves as an undercut cavity or T-shaped lock. In constructing the wall the veneer blocks are set up in courses which break joints in the usual manner, and the concrete is poured in between them and a temporary backing. The material flows into the undercut cavities, securely bonding the blocks to the concrete wall. Each block is formed with air spaces, which register with similar spaces in the courses above and below, so that continuous vertical air passages are formed throughout the wall. The concrete wall is also poured to form air passages back of each joint in the veneering, so that moisture seeping through the joint will be arrested by the air space. The invention can be applied to face brick, terra cotta, or cement blocks, and the face of the blocks can be molded to represent cut or rough stone, or any other desired pattern. The system may be employed on the tallest reinforced concrete structure, eliminating the expense of forming front panels for the face of the wall, while plain or ornamental designs can be molded at a cost only a trifle over that of the concrete displaced by the blocks.



AN IMPROVED CONCRETE WALL CONSTRUCTION.

A NOVEL FLAG HOLDER.

The accompanying engraving illustrates a novel device for displaying flags for decorative purposes. The device is of very simple design, adapted to be attached either to a window or a door casing, or to posts and pillars in halls, or it may be used on floats and wagons. It consists of a block formed with a beveled edge at one end, so as to enable the flags to extend outwardly when attached to a support. The opposite

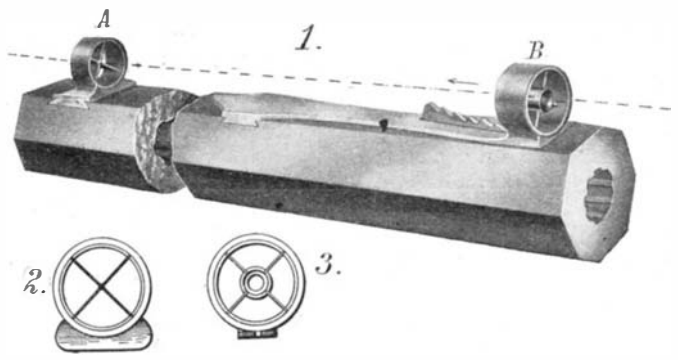


A NOVEL FLAG HOLDER.

end of the block, or standard, is rounded, and drilled into this rounded edge are a series of holes which extend to a slot formed in the face of the standard. These holes are adapted to receive the flagstaffs. In order to prevent the flag from slipping out of these sockets, a screw eye is fastened into the end of each staff, and a locking bar which extends transversely through the standard is adapted to engage these screw eyes, thus holding the flags firmly in place. It will be noted that the flag holder is exceedingly simple and inexpensive in construction, that it requires no skill to adjust it to its support, to which it may be secured by means of screws, and that when once secured in place it will remain in such position through any kind of weather without injury to the holder. Moreover, the holder dispenses with the necessity of nailing the flagstaffs to a window or casing, which would soon render the flags unfit for use, but on the contrary, with this holder the flags may be repeatedly used without injury to the flagstaffs, and without danger of their being stolen by passersby. The inventor of this novel flag holder is N. S. Makepeace, 213 East Monument Avenue, Dayton, Ohio.

A NEW RIFLE SIGHT.

A "bead and aperture" sighting system for firearms that possesses all the advantages of the old "peep and globe" sights without having any of their bad features has been invented by Mr. Charles G. Thunen, of Oroville, Cal. Both front and rear sights are cased in a circular cover, so that all danger of injury to the "bead" or to the "peep" is done away with. The objection that an aperture sight is a hindrance to quick shooting is removed by an ingenious bit of construction that enables one to see not only the mark, but also its surroundings, giving an aim that is quite as accurate as that obtained with the "Buckhorn," or similar type of open sporting sight, and in a much shorter time. The following is an explanation of the drawing: Fig. 1 is an elevation of the improvement as applied to the barrel of a gun. Fig. 2 is an enlarged rear elevation of the front sight. Fig. 3 is an enlarged rear elevation of the rear sight, the spring plate being shown in section. The front sight *A* and the rear sight *B* are mounted in the usual manner on the barrel of the rifle or other firearm on which the sights are used. The front sight is held in a ring having a dovetailed base fitting a correspondingly



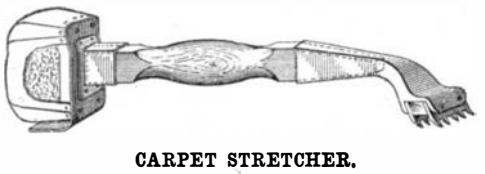
A NEW RIFLE SIGHT.

shaped groove on the barrel, in the usual manner for fitting sights. Within the ring is fitted a tubular support carrying cross strips, of which one is provided at its center with a slot for receiving a portion of the other strip, the latter having at the intersection of the two strips a bead of aluminium or some similar metal. The outer ends of the strips are fitted into slots in the tubular support, so that the latter carries the cross strips, one of which centrally supports the bead. The strips are arranged at right angles one to the other, and are preferably placed at an angle of 45 deg. to the vertical.

The rear sight is mounted on a ring held on the shell spring-plate and has the usual notched plate for adjusting the elevation. Within the ring is fitted a tubular support carrying cross strips centrally supporting a sight-tube, the axis of which coincides with the axis of its tubular support and with the axis of the bead of the front sight. These cross strips are also arranged at right angles, one to the other, and are also preferably placed at an angle of forty-five degrees to the vertical. This arrangement gives a set of sights which allows of simple and durable construction, and is arranged to stand rough usage. It also permits an exceedingly accurate aim to be taken without the danger of blurring, owing to the settling of rain or mist in the aperture. Since the metal parts making the actual sighting system are extremely thin, there is no danger of the usual *burring*, which is so annoying with sights of heavier construction.

CARPET STRETCHER.

A most powerful carpet stretcher has recently been invented by Mr. John Driver, of San Leandro, Cal. The device belongs to the type adapted to be pushed forward by knee pressure, and its operation is clearly illustrated in the accompanying engraving. It comprises a handle tapered at one end to enter a socket in a claw holder, while the opposite end is secured to a plate of L shape on which the knee cushion is supported. The claw holder is provided with a forked head at its outer end, in which a pair of toothed plates are secured. These toothed plates are spaced apart by a block of wood, which wedges them into the forked head. In this position they are also held by means of screws. The L-shaped plate at the opposite end of the stretcher is arranged to extend under the knee cushion, so that when it is placed upon the floor it will raise the cushion slightly above the carpet to prevent it from wearing; and since the plate is of

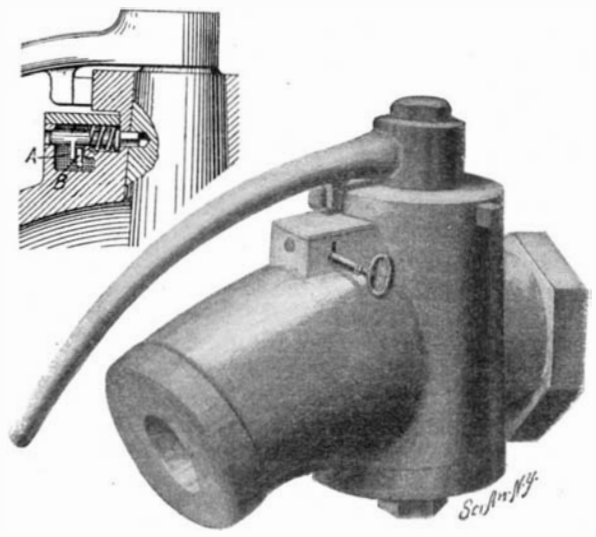


CARPET STRETCHER.

metal, it will not offer as much friction as would the knee cushion, which is provided with a leather covering. In using the invention, the teeth are set in the carpet at a requisite distance from its edge, and then with the plate at the opposite end resting on the floor, the operator forces the device forward either by a steady pressure or by a succession of blows, until the carpet is stretched to the required degree. A most powerful pressure can thus be secured. It has been found in practice that with this stretcher the operator can move a weight of over 300 pounds when placed on a loose strip of carpet, and also that the tacks may be pulled up on the opposite side of the room if the operator uses too much force. One of the important advantages of this stretcher is that it may be held with the knee, permitting the operator to use both hands to drive tacks.

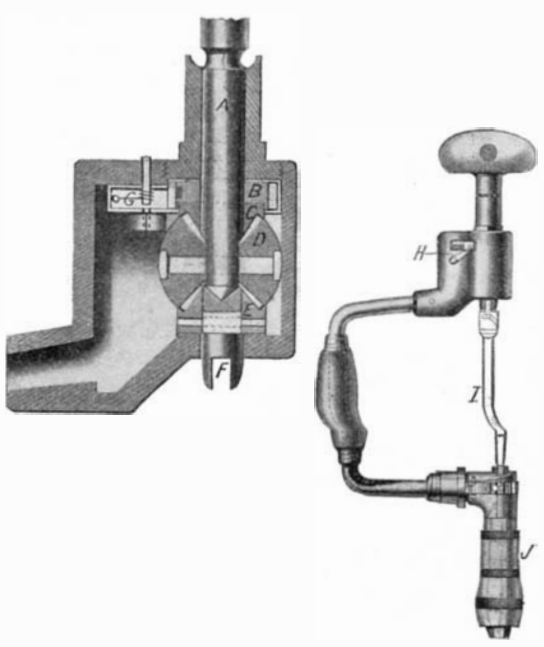
SAFETY COCK.

A patent has recently been secured by Mr. James C. Stratiff, 1322 Pennsylvania Avenue, Tyrone, Pa., on a



SAFETY COCK.

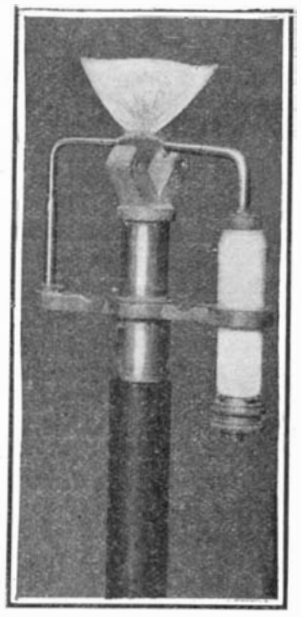
cock provided with means for locking the plug, so that it cannot be tampered with by an unauthorized person. The invention is particularly adapted for use on angle cocks, such as are commonly employed with an air-brake system. The details of the locking mechanism are clearly shown in the accompanying engraving. A chamber is formed on the body of the cock to one side of the plug. Mounted in this chamber is a locking bar or bolt, which is adapted to pass through an opening in the wall of the chamber and into a recess in the plug. In this position the bolt is held by a coiled spring. Depending from the bolt is a projection, which is adapted to be engaged by a key. The key is passed through a keyhole in one side of the chamber, and its inner end is supported in a recess in the opposite side of the casing. By turning this key the bolt may be withdrawn from engagement with the plug, and the latter may then be turned by operating the handle with which it is provided. This handle is formed with a projection which is adapted to engage a pair of stops, and thus limit the movement of the plug. When the plug is turned to close the cock, it is stopped by the stop-piece in such position that the recess therein is brought into alinement with the bolt, and the latter is thereupon forced in by the spring, engaging the plug and holding it against rotation. When in this position, it is evident that the plug cannot be turned except by a person provided with the proper key. While this invention is particularly adapted for an air-brake cock, it will be obvious that it may be applied to any cock of the plug type.



AN IMPROVED BIT BRACE.

ELECTRIC GAS-LIGHTER FOR ACETYLENE AUTOMOBILE LAMPS.

A simple and ingenious little appliance for making it possible to light the gas lamps of an automobile by working a switch on the dashboard is illustrated herewith. This attachment consists of a horizontal arm which fits tightly upon the slightly tapered pipe of the burner and which supports, at each end, a right-angled wire sparking point as shown. The points face each other above the burner, one of them being supported in a porcelain insulator which is securely fastened and held from turning. Both points, however, can be turned to one side if at any time it is necessary to remove the lava tip, and they can also be adjusted slightly in height by turning them around. The insulated sparking point is connected by a wire to one side of a two-point switch on the dashboard, the other side being connected to one of the spark plugs and the movable arm of the switch being connected to a secondary terminal of the spark coil. When it is desired to light the gas, by changing the switch, the spark is diverted from the plug to the gas-lighter. This does not interfere with the running of the engine, as it is only done momentarily, and as soon as the gas is lighted, the switch is turned back. The high-tension current, after jumping the gap at the burner, returns to the ground terminal of the spark coil, since the other point of the gas-lighter is grounded. If it is desired to light two gas lamps at the front of the car, a three-point switch is used, and the second lighter is connected to one of the points of the switch in a similar manner to that just described. As the wires of the lighter are rather large and are not pointed at their ends, a series of arch-shaped sparks are obtained, which readily light the gas although the points are below the bottom of the flame and hence are not subjected to its intense heat.



ELECTRIC GAS-LIGHTER FOR ACETYLENE AUTOMOBILE LAMPS.

The inventors of this new device are Messrs. Kapp and Alviset, of Portchester, N. Y.

AN IMPROVED BIT BRACE.

With the ordinary ratchet bit brace, when operating in a corner, or in a place where the sweep must be oscillated back and forth, instead of making a full turn, only the forward stroke is effective in driving the bit into the wood, the return stroke being used to move the pawl to a new hold on the ratchet. When beginning to bore the hole, the operator must hold the bit with one hand until it is sufficiently imbedded in the wood to overcome the friction of the pawl upon the ratchet during the return stroke. This is not necessary with the new bit brace which is here illustrated; for it operates to drive the bit continuously both on the forward and the return strokes. The construction of this bit brace is similar to that of the ordinary brace, except for a ratchet attachment at the upper end of the sweep. This improvement is shown clearly in the cross-sectional view. The head of the brace is secured to a shaft *A* on which is mounted a ratchet *B* and a bevel gear *C*. The latter are keyed to each other, but are adapted to move freely on the shaft. Engaging the bevel gear *C* are a pair of bevel gears *D* securely fastened to the shaft *A*, and these in turn mesh with a fourth bevel gear *E*, which is secured to a short shaft *F*. The latter projects through the casing in which the gears are contained, and is formed with a forked head. The ratchet *B* is engaged on opposite sides by pawls *G*, which may be thrown into or out of engagement by means of a swivel catch *H*. The casing which contains this gearing is secured to the upper end of the sweep. The lower end of the brace is of standard construction, except that the spindle is provided with a slotted upper end. In use when it is possible to give a full turn to the sweep, the brace operates the same as the standard ratchet brace; but when working in a corner, a connecting rod *I* is fitted between the forked shaft *F* and the slot in the spindle. This is shown in outline in our engraving, indicating that the rod is removable. Then one or other of the pawls *G* is thrown into engagement with the ratchet *B*, according as to whether the bit is to be turned to the right or the left. Now, on oscillating the sweep back and forth, the pawl of the lower ratchet will first act to turn the spindle in the usual manner, and then the pawl *G*, operating through the medium of the connecting rod *I*, will serve to continue this movement while the first pawl is reset. Thus the operation will continue with the upper and lower ratchets alternately driving the bit. A patent on this bit brace has been secured by Messrs. Karlson & Gran, 134 Oak Street, Chicago, Ill.

Brief Notes Concerning Inventions.

A new method of preserving milk in closed vessels for an indefinite period has been perfected by an inventor of London. The process consists in eliminating the air and replacing it by carbonic acid gas. Prof. Macfayden, the bacteriologist, has asserted that if all the micro-organisms could be excluded, milk would never go sour, and by aeration this claim has been substantiated. Carbonic-acid gas possesses decided antiseptic qualities, and is harmless when consumed with food. In this manner milk can be stored in bottles or other similarly sealed vessels for a prolonged period without souring, as experiments have demonstrated. Similarly, owing to the antiseptic properties of the gas, aeration completes sterilization carried out by the dairyman. In the case of those who do not like the flavor of aerated drinks, the milk can be easily stilled by pouring it into an open vessel such as a glass or jug and leaving it exposed to the air for a short time.

A new toy brought out for the holiday trade is a gas cannon. It is alleged to be entirely safe and is intended to amuse the small boy. The cannon is mounted on a box and the latter contains a small acetylene gas generator. It is supplied with a safety device rendering accidents and injury to the tiny operators quite impossible. The gas is led to the cannon through a tube and when it is loaded with a small ball of wood, the discharge is effected by an electric spark.

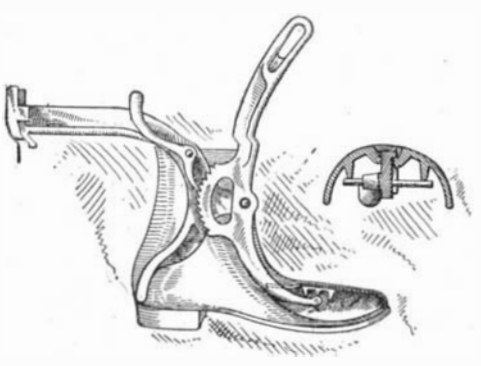
ODDITIES IN INVENTIONS.

Fountain Blacking Brush.—A novel blacking brush has recently been invented, which is provided with a reservoir for water and a means for conveying this water to the bristles of the brush at the will of the operator. The reservoir, which is shown in section in the accompanying engraving, is placed directly over the brush proper, and at its lower end is provided with an outlet normally closed by a valve. The valve is

FOUNTAIN BLACKING BRUSH.

connected to a thumb-piece situated in the handle of the brush, and is normally kept in closed position by a spring. In use, when the operator desires to admit some of the water to the brush, he depresses the thumb-piece, opening the valve, and permitting the water to flow into a chamber directly above the bristles. Extending through the bottom of this chamber are a series of small ducts, which distribute the water to the bristles.

Shoe Holder.—A resident of Chicago has invented a simple holder for shoes, which may be readily adjusted to different sizes of shoes, and which will automatically regulate itself to right and left shoes. The device will exert a uniform pressure upon the entire toe and instep of the shoe, supporting and stretching these parts while the shoe is being shined or polished. The construction of the holder is clearly indicated in the accompanying engraving. The toe piece is detachable, permitting the substitution of different sizes of toe pieces to fit men's, ladies', and children's shoes. In order that the toe piece may have free movement to conform to the shape of the front portion of the toe of every shoe, it is made capable of a partial rotary movement in a horizontal plane, that is on a vertical axis.



SHOE HOLDER.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SHIELD.—MAUD E. PATTERSON, Baltimore, Md. This shield is for attachment to a corset to prevent the upper ends of the busks from exerting an undesirable pressure against the wearer's body. It is readily fastened in place on the corset and disconnected from one side thereof whenever it is desired to open or close the corset. By use of the shield all undue chafing by the upper end of the corset busks on the body is entirely removed.

GARMENT-FASTENER.—J. H. WHITE, Electra, Cal. The fastener is intended for use in joining the parts of garments and other fabrics. It is particularly useful as a skirt-fastener. The inventor's object is to provide a fastener the parts of which may be engaged with each other by a very slight movement and which when engaged will hold securely.

STICK-PIN RETAINER.—R. CORN, New York, N. Y. One of the purposes of this improvement is to provide a device especially adapted for use in connection with stick-pins, being removably applied to a pin after it has been passed through the scarf or tie or similar article to prevent withdrawal of the pin without the wearer's knowledge, the device being concealed when worn.

SLIPPER-SOLE.—I. GREENBERG, New York, N. Y. It is the principal aim of the invention to provide means whereby the upper and sole can be secured together without passing any threads through the sole or exposing them in any way to hard usage and also avoid the use of any material in conjunction with the sole that would interfere with its pliability.

Electrical Devices.

INTERRUPTED CONTACT FOR THIRD-RAIL SYSTEMS.—A. S. KATZMAN and H. A. VIZETHANN, New York, N. Y. This invention relates to contact mechanism and more particularly to contact mechanism suitable for use upon third-rail trolley systems and in all relations where it is desirable to have a conductor which is normally dead, but which is energized momentarily upon the approach of a member of rolling-stock properly equipped for utilizing the current.

ELECTRIC SWITCH.—G. W. LIDEN, New York, N. Y. The improvement refers particularly to "knife-blade" switches, and has for its object to provide a readily-applied latch which will automatically lock the switch as it is closed and automatically unlock it as it is opened. A strong connection is made between the fuses and their binding-posts, necessitating the use of but a single screw.

Of Interest to Farmers.

LAWN-MOWER:—J. A. SWENSON, New York, N. Y. The mower while capable of use for the ordinary operation of mowing lawns is especially designed for use in clipping around the edges and in places inaccessible by ordinary lawn-mowers. The invention locates the cutting-knives in such a position that they will cut to the surfaces of fences, trees, and other obstructions and provides means whereby the cutting-knives can be readily manipulated by hand.

BALING-PRESS.—W. D. IVY, Memphis, Tenn. This baling-press is such as is used for baling hay. The object of the invention is to produce a press of this class which may be operated by a rotating member, so that the plunger of the press will make two advancing movements for one revolution of the rotating member. Means provide for facilitating the forming of the bale.

REELING DEVICE.—C. A. HADLAND, Bennington, Minn. One purpose of the invention is to provide an improvement upon the reeling device for which Letters Patent were formerly granted to Mr. Hadland, the improvement adapting the attachment for use on all kinds of ground, since an especial chain-drive is adapted thereto, whereas in the construction set forth in the said patent a friction-drive is employed, and in very tenacious soil such a drive is not reliable.

HAY-RAKE.—J. W. HURD, Dona, Va. The purpose of the inventor is to provide a folding horse hay-rake whereby it can be made long or short, as desired, and be equally effective, under either adjustment. It provides a construction of rake wherein the various parts are not disconnected when effecting the adjustment, thereby preventing the loss of the adjustable parts.

POTATO DIGGER AND ASSORTER.—J. P. HERBERT, H. S. PRICE, and E. J. PRICE, New Brunswick, N. J. The principal objects of the invention are to provide a vehicle which is adapted to be drawn by horses or any kind of motive power with means for taking up potatoes or other roots on the wheels of the vehicle, delivering them to a series of assorting-screens on the body of the vehicle, and finally discharging them in a series of receptacles arranged at a convenient place for receiving different sized potatoes.

WEED-CUTTER.—R. W. STEELE, Twin Falls, Idaho. The cutter is drawn with the knives lowered into the ground from one to four inches. The weeds are cut off beneath the surface, and the fingers loosen them from the soil and leave them so that the attachment behind the finger-bar may easily pile them into windrows on either side of the cutter. Means are used to set the knives to cut at any depth, and to level the frame to a horizontal plane regardless of the position of the tongue. Thus, one knife acts as a landslide for the other and prevents all side drafts.

STALK-CUTTER.—T. M. YARBROUGH and R. C. BRADLEY, Bossier Parish, La. The invention is in the nature of a machine to be drawn across the field by a double team for the purpose of cutting into small pieces the standing stalks of cotton, corn, etc., after the crop has been harvested. It requires no more power than the ordinary plow. It tops and cuts millet, sorghum, okra, and other products. Mechanical power can be used.

PLOW.—E. R. LOVELL, Brookhaven, Miss. The invention refers particularly to attachment and support of colters. By adjustment the plow runs shallow or deeper. The rear end of the draft-bar is bent upward and the upwardly-extended shank of the colter is detachably and adjustably secured to it by means of a U-shape screw-bolt, the same embracing the colter-shank and the rear-end mentioned. The colter also requires to be supported to a point below the beam, and for this purpose a brace is employed. It also supports the colter's rear arm and serving as a grass rod or fender. The colter is adjusted higher or lower by means of the screw-bolt.

Of General Interest.

CIRCULAR-DISTRIBUTER.—R. G. FRASER, Philadelphia, Pa. The device holds circulars and the like in such a position that they can be readily withdrawn by the public; and the principal objects of the invention are to provide means whereby only one can be withdrawn at a time and means for always holding a circular or similar article in a position where it can be readily abstracted from the holder.

DROP-REGULATING BOTTLE.—A. WILKIN, New York, N. Y. The invention pertains to improvements in bottles, and more particularly to means whereby the contents may be removed therefrom in drops of uniform size. The object is to provide a means of the character above referred to and in which the inclination of the bottle does not affect in any way the size of the drops.

TUNING DEVICE.—C. S. WEBER, New York, N. Y. The device is for pianos and similar stringed instruments wherein a metal plate is used to resist the strain of a number of metallic strings. The object of the inventor is to do away with the wooden tuning-block or wrest-plank used to-day almost exclusively, either shielded by the iron plate or exposed, to keep the tuning-pins of a piano from slipping.

DISPLAY-RACK.—J. E. TAYLOR, Jackson, Miss. In this case the improvement refers to display-racks, and the object of the invention is the production of a device of this class which is adapted to support a plurality of mattresses and which will enable the same to be drawn out into a convenient position for inspection.

WATCH-GUARD.—A. SCHNEIDER, New York, N. Y. The object in this instance is to provide means adapted to prevent a watch from falling out of the pocket or being removed therefrom without one's knowledge. The clamping-arms have the resiliency to permit the arms to be snapped onto the bow of a watch and the interior surface of said arms is curved to correspond with the outward curvature of the watch-bow, so as to prevent lateral displacement of the arms on the bow.

STEP-LADDER BRACE.—E. ROWE, Indiana, Pa. The intention in this case is to produce a brace which is adapted to brace the legs of the ladder so as to hold the same in upright position. The resiliency of the brace, together with its construction, brings about a desirable "give" or play, which has a tendency to prevent the ladder from "walking" or moving laterally when the weight upon it shifts.

PROCESS OF FORMING BUILDING MATERIAL.—J. OLTMANNS, Rintheim, Baden, Germany. The process is one of manufacturing slabs or blocks of material for use in the construction of walls, partitions, ceilings, floors, and the like, the object being to provide a light material but possessing great firmness and strength, that will be practically a non-conductor of heat and cold, that will not be influenced by changes in temperature, fire and sound proof, and that on account of cheapness of raw material may be produced at low cost.

URINAL.—A. JOHNSON, Lincoln, Neb. In the present patent the purpose of the invention is the provision of an automatic flushing device for urinals, one which will be economic in the use of water and which will insure at all times sanitary conditions. A simple and economically constructed mechanism accomplishes the above-named results.

VETERINARY'S OPERATING-TABLE.—W. HOUSAM, O'Fallon, Ill. In this invention the improvement relates to operating-tables, and especially to such as are used by veterinary surgeons. The object of the inventor is to produce a table of this kind which may be readily operated so as to enable the animal to be securely held and brought into a convenient position for the operation.

COMPOUND FOR CLEANING AND POLISHING METALS, PORCELAIN, GLASS, ETC.—C. J. BARRENPOHL, New York, N. Y. This is an improved compound for cleaning and polishing metals, porcelain, glass, etc., without injury to the same, and giving them a cleaner appearance and a higher luster than has been hitherto obtained in compositions for this purpose, and it accomplishes this with little muscular exertion of the user.

COMPOUND FOR CLEANING AND POLISHING WOOD SURFACES.—C. J. BARRENPOHL, New York, N. Y. Primarily the objects of the invention are, to produce a compound that will not only effectually remove finger-marks and other collected dirt without affecting the wood, but will simultaneously with its application give the surface a high retaining polish and in addition close up the small openings in the grain of the wood, thus performing the function of a "wood-filler."

BUCKLE.—L. SANDERS, New York, N. Y. One purpose of this invention, which relates to buckles having frictional locking-tongues, is to so construct such a type that the tongue will automatically adapt itself to straps of different thicknesses, rendering the buckle particularly adaptable as a belt-buckle. It is conveniently and expeditiously operated.

CLOTHES-PIN.—S. PASQUALIN, New York, N. Y. The invention is an improvement in clothes-pins, relating to those more particularly in which spring clamping-fingers are employed. One object of the inventor, among others, is to simplify and reduce the cost of this form of pin, especially avoiding the use of pivot-pins and rendering it more effective in operation than those hitherto devised.

PIPE-CLAMP.—L. KRUEGER, E. J. KINKLER, and O. H. CARMICHAEL, Beeville, Texas. This pipe-clamp is an improvement for lowering and raising tubes, especially well-casings, shafts, and the like. It is of simplified construction and will when in operation automatically grip and lightly clamp the pipe or shaft and can be readily removed therefrom when desired.

SOAP-HOLDER.—J. EVANS, JR., and G. A. STEINER, Salt Lake City, Utah. Generally stated, the invention consists of a chambered head on which a spring-pressed piston is slidably mounted, the latter being adapted to engage with and lock a pin which is passed through the soap and thereafter inserted in the head in alinement with the movement of the piston. The locked bar of soap may be suspended in public and private toilet rooms, and the soap can be neither wasted nor carried away.

WHISTLE-ORGAN.—J. O. EARLEY, JR., Richmond, Va. When the pedals are actuated, air is pumped by bellows by way of tubes into a reservoir, from which air can pass by a tube into the main wind-chest. On pulling one, two, or more stops, air passes from the above chest into another chest, and on playing the keys corresponding caps are moved from the entrance ends of corresponding whistles, the latter sounding to produce sounds corresponding to the keys pressed. Releasing the keys, they return to position, and the caps move back over the entrance end of whistles to cut off the latter's air. By manipulating the keys according to the music, the piece is performed the same way as if organ-pipes or piano-strings were sounded in the usual way.

DEVICE FOR RENDERING BOTTLES NON-REFILLABLE.—V. CLARK, Dryad, Wash. Mr. Clark's improvement relates to that class of bottles designed to prevent the clandestine and fraudulent refilling of bottles, and has for its object to furnish a cheap and effective means of preventing such refilling without detection. The guard prevents refilling without breaking the bottle or parts of the guard, as they are all made of glass.

GRAVE-FILLER.—W. S. PENDLETON, Shawnee, Oklahoma Ter. The invention resides in a form of hopper intended to hold all the removed earth of one grave and a peculiar supporting-truck, the latter employing transversely-arranged axles at its ends having supporting wheels suitably arranged on their ends, whereby to facilitate movement of the device as required during the grave digging and filling operation.

BOAT-PLUG.—G. W. RENTON, Brooklyn, N. Y. The object of the present invention is to provide a construction whereby to overcome difficulties resulting from clogging of parts by the painting of the boat and also means for preventing the cap from becoming detached from the fixed or body portion of the plug, together with the construction of the cap, whereby it will close the opening when the cap is screwed down. It is an improvement in plugs—such, for instance, as that shown in the former patent granted to Mr. Renton.

DIRT-CARRIER.—J. H. MORAGNE, Honolulu, Territory of Hawaii. In operation the rings of the bails are placed upon angular portions of the hanger, the trigger is elevated and engaged by the eye of the rocking lever, after which the bucket is filled and elevated to the track. At the unloading place means provide for dropping the bucket until the rope secured to the bottom thereof becomes taut, when its vertical axis is reversed and the load drops. Either a curved or straight rim wheel can be used with the track, the curved when lifting the bucket from the excavation or using a cable in connection with the track. A guard prevents derailment of the hanger-wheel.

SPRING DEVICE FOR PRODUCING DIFFERENTIAL MOVEMENTS.—W. V. GILBERT, 30 Lonsdale road, Wanstead, N. E., London, England. The device is an embodiment of variations of a basic invention for which Mr. Gilbert formerly filed an application for a United States patent. By the construction of the device, the inventor is able to obtain differential movements of two wings or of either wing relative to the other, or of either end or outer corner of each wing relative to the other end of the same, also of the triangular back components to each other. The device in practice can be used in various positions.

BUTTER WEIGHING AND COMPUTING DEVICE.—D. F. CURTIN, St. Louis, Mo. The object of this invention is to produce a device which shall be simple and convenient and one by means of which a roll, cube or pat of butter may be cut of a predetermined size and weight and in which the price of the butter, etc., is immediately computed.

Hardware.

SQUARE.—L. V. SHEPHERD, Los Angeles, Cal. The object of the invention is to provide a square for the use of carpenters, machinists, and other mechanics, and arranged for convenient detachment of the members to permit the mechanic to readily carry the square in the tool-chest, and to allow of quick and accurate assembling of the members whenever it is desired to use the square for its legitimate purpose.

POCKET-KNIFE.—S. SAUNDERSON, Northwood, N. D. The object in this instance is to provide a knife having a blade capable of being concealed and locked in the handle and adapted to be extended for use and held locked in the extended position without the use of springs and to prevent accidental closing while using the knife for its intended purpose.

GAGE.—C. A. GOOD, Jonesboro, Ark. Primarily the invention is to be used for marking beveled siding or weather-boarding, so that a perfect fit can be made at the joints, where the boarding joins the corner boards, window-frames, etc. The object is to overcome numerous difficulties in making neat joints and to correctly indicate the line on which the siding is to be cut, enabling a perfect joint to be obtained.

SWIVEL.—R. H. BEEBE, Kalama, Wash. The members of the device may be quickly assembled and taken apart, and in operation the attaching members are held secured in position, yet adapted to rotate independently of each other. The bearings for the flanges of the eye or hook are protected from dirt and other foreign matter, thereby enabling operation without unnecessary friction and adding to the wearing qualities of the device and enabling the swivel to last much longer in use than those of ordinary construction.

Heating and Lighting.

SAD-IRON HEATER.—H. W. RUSSELL, Manchester, N. H. The direction of this invention is in heaters designed to heat sad-irons. The object is to provide a gas-heater which is adapted to be used with the least possible expenditure of gas, to render the use thereof absolutely safe, and to enable the heater to be used without generating the offensive odor common to devices heretofore used.

Machines and Mechanical Devices.

PIANO-ACTION.—J. AMMON, New York, N. Y. The object of the inventor is to provide a piano-action, arranged to simplify the action by dispensing with the bridle and bridle-wires, and at the same time insuring a proper return movement of the hammers without danger to the coacting parts, and to cause a quick response of the hammers according to the touch on the keys.

ORE-CONCENTRATOR.—A. C. CAMPBELL, Asheville, N. C. In the present patent the invention has reference particularly to pneumatic ore-concentrators, an object being the provision of simple construction and by means of which the work may be rapidly carried on and a thorough separation secured.

CHUCK.—J. HODSON, Portland, Ore. The chuck is particularly intended for use in manipulating stay-bolts of boilers, the object being to permit these devices to be placed on or removed from the boiler without necessitating squaring the end of the stay-bolt and to enable the bolt to be screwed up so far as to render it unnecessary, in some instances at least, to cut off the projecting end of the bolt.

PUMP.—C. A. NEYLAND, Lewiston, Idaho. The purpose of the invention is to provide a construction of pump especially adapted for irrigating purposes which will be automatic, and continuous in its action, the pump being particularly designed to operate by the current of a body of water, and also to so construct the device that two pumps are coupled together to form one complete pump, each individual pump having two plungers which operate simultaneously, but in opposite directions.

PRESS.—E. R. DERRY, Leadville, Col. Primarily the object of this invention is the production of an effective press in which both the movable and stationary tools or dies may be readily changed to suit the character of the work required, also providing for automatically

locking the movable tool on grasping the hand-lever employed in reciprocating it.

VENEER-CUTTER.—E. BECK, New York, N. Y. This mechanism is designed for cutting veneers from a log. Machines in common use are used which revolve in one direction and are large in size, and reduce the number of veneers. If thinner saws are used they tend to cut into the grain to lead from the path of truth, thereby injuring the veneer and saw. The invention overcomes such difficulties and inconveniences and provides means enabling an increased number of veneers to be cut from a log.

MACHINE FOR PRODUCING ORNAMENTAL SURFACES OR FLEECED FABRICS.—C. H. FRENCH, Canton, Mass. The invention relates to cloth-finishing machines; and its object is to provide a machine for producing ornamental surfaces on fleeced fabrics—such, for instance, as shown and described in the application for Letters Patent of the United States, formerly filed by Mr. French, the machine being arranged to provide permanent ornamental surface in the form of alternating transverse stripes of coarse and fine texture.

FOLDER ATTACHMENT FOR HEMMERS.—E. F. GIBBONS, Jersey City, N. J. The object of the present invention is the provision of an attachment for sewing-machines affording means for folding the material before presenting the same to the hemmer, the general purpose being to dispense with hand operators, who fold the goods in the same manner.

MOLDING APPARATUS.—L. HANSEN, Oshkosh, Wis. In this instance the invention is an improvement in molding apparatus adapted for the manufacture of roofing-tiles and similar products from concrete or other plastic medium. The machine may be employed for making bricks, slabs, building-blocks, or other suitable objects of the above named materials.

Prime Movers and Their Accessories.

DRAFT-REGULATOR FOR STEAM-BOILERS.—A. J. SNOW, Fromberg, Mont. This invention is an improvement in draft-regulators for steam-boilers, more especially boilers for locomotives or the like, and has for an object, among others, to provide automatic means to prevent the suction of cold air by the exhaust of the engine through the fire-box and boiler-flues when the fire-box door is for any purpose open.

STEAM-ACTUATED VALVE.—E. A. MENKING, Pittsburg, Pa. The object of the invention is to provide a valve, more especially designed for steam-pumps and like machines and arranged to insure an easy and automatic shifting of the valve for controlling the admission and exhaust of steam to and from the cylinder. It relates to valves such as shown and described in Letters Patent of the United States formerly granted to Mr. Menking.

COMBINED AIR AND GAS ADMISSION VALVE FOR EXPLOSIVE-ENGINES.—H. LENTZ, Berlin, Germany. The invention relates to valves of explosion or internal combustion engines supplied with a mixture of air and gas or hydrocarbon vapors; and the object is to provide a valve consisting of a single member combining in one part the air and gas admission valves.

Railways and Their Accessories.

CAR-WHEEL.—T. L. HAWKINS, Pittsburg, Pa. The invention relates to railroad and mining cars having the wheel mounted to rotate loosely on the axles. The parts are readily assembled and by the use of the bearing balls engaging the recesses in the journal and the hub the car-wheel is held against longitudinal movement on the journal and without undue friction or binding of the parts. In case the journal and the bushing become worn to a considerable extent it is only necessary to replace the worn-out bushing by a new one, so that the axle as well as the car-wheel can be used. The improved renewable bushing, closed hub, self-oiling, and dust proof car-wheel are adapted to mine cars only.

Pertaining to Recreation.

DUST-PROTECTOR FOR POOL AND BILLIARD TABLES.—L. J. DIRAND, Torrington, Conn. The purpose of this invention is to improve the protective cover for which Letters Patent were formerly granted to Mr. Dirand, which improvements tend to simplify the construction and render the attachment adjustable to different heights of table, enabling the cover to lie close to the upper marginal portion of the table, and, further, to so construct the attachment that when not in use it may be dropped to occupy a position out of the way of the players.

TOY.—W. V. GILBERT, 30 Lonsdale road, Wanstead, N. E., London, England. Mr. Gilbert makes use of a flexible or spring device, which forms the subject of his application for patent formerly filed by him. It is formed from a resilient plate bent into such shape that by compression and release from compression it alternately projects and retracts the eyes. Means provide for its appearing to spring or jump, and this being accompanied also by retraction or return to original position of certain movable parts the simulation to a living animal is rendered more complete.

AMUSEMENT DEVICE.—E. N. CHAMBERLAIN, Natchez, Miss. This sounding toy is adapted for attachment to the foot beneath the arch of the same in front of the heel, it being in practice made of normally greater vertical diameter than the height of the heel, so that when the foot is pressed down or rests upon the floor or other surface the bulb will be compressed and a sound emitted.

Pertaining to Vehicles.

AUTOMATIC WAGON-BRAKE. — E. F. VEATCH, Palco, Kan. This brake may be easily applied to an ordinary wagon and may be used with or without the bed, being equally efficient in both cases. It is simple in construction and entirely automatic in action and is not liable to get out of order easily. Since considerable strain is brought to bear on no part, danger of breakage is reduced to a minimum.

VEHICLE-WHEEL.—P. E. DAWSON, Hancock, Md. In the present patent the object of the invention is the production of a wheel which shall be distinguished by great resiliency, strength, and durability of its rim portion, the same being a punctureless elastic tire and air inflation being dispensed with.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(10462) H. L. O'B. asks how to make citric acid from fruit. A. Citric acid is generally manufactured from lemon juice, which is imported in a concentrated state produced by evaporation by heat. It consists of citric acid 6 to 7 per cent, alcohol 5 to 6, and the remainder water, inorganic salts, etc. By some manufacturers it is allowed to partially ferment for the purpose of evaporating the clear liquor from the mucilage, or it may be clarified in the usual method by the use of albumen in the form of the white of an egg. Carbonate of lime in fine powder is gradually added, and stirred in so long as effervescence continues. Citrate of lime forms, and after being separated by drawing off the watery liquor, is well washed with warm water. It is then intimately mixed with strong sulphuric acid diluted with 6 parts of water. After some hours the citrate is decomposed, the sulphuric acid having taken up the lime and formed an insoluble sulphate, setting the citric acid free. This, separated by decanting and filtering, is evaporated in leaden pans till it attains the specific gravity 1.13. The evaporation is afterward continued by a water or steam bath till the liquor begins to be sirupy, or to be covered with a thin pellicle. It is then removed from the fire, and put aside to crystallize, the mother liquor after a few days being evaporated as above, and again set to crystallize, and so on as long as clear crystals are obtained. To obtain pure citric acid, all the crystals should be redissolved and recrystallized, it may be several times, and the solution digested with bone black. A gallon of lemon juice should make about 8 ounces of crystals. Limes and lemons constitute the source from which citric acid is generally made, yet it may be extracted from oranges, currants, gooseberries, raspberries, tamarinds, etc. The machinery and cost of manufacture will depend upon circumstances which any one about to go into the business can best judge.

(10463) C. L. G. asks how to make koumiss. A. 1. Fill a quart champagne bottle up to the neck with pure milk; add two tablespoonfuls of white sugar, after dissolving the same in a little water over a hot fire; add also a quarter of a two-cent cake of compressed yeast. Then tie the cork on the bottle securely, and shake the mixture well; place it in a room of the temperature of 50 deg. to 95 deg. Fahrenheit for six hours, and finally in the ice box overnight. Drink in such quantities as the stomach may require. Be sure that the milk is pure; that the bottle is sound; that the yeast is fresh; to open the mixture in the morning with great care, on account of its effervescent properties; not to drink it at all if there is any curdle or thickening part resembling cheese, as this indicates that the fermentation has been prolonged beyond the proper time. 2. To a quart of new milk add a sixth part of water, and to this mixture add, as a ferment, an eighth part of the sourest buttermilk that can be got. In future preparations, a similar quantity of old koumiss will better answer the purpose of a ferment. Cover the vessel with a cloth, and allow to stand in a place of moderate warmth for twenty-four hours, when a thick substance will be found collected at the top. Stir well until this substance is thoroughly mixed with the liquid portion beneath, and allow to stand for twenty-four hours more, when, having filled a bottle two-thirds full, and again thoroughly mixed by shaking, the preparation, now called koumiss, may be used at once, or the bottle tightly corked and kept in a cool place for future use. Always shake the bottle well before using.

(10464) P. D. asks how to make imitation leather. A. A mixture recommended consists of 16 parts gelatine and 5 parts glycerine. A coloring matter is then added as may be required—caoutchouc to give elasticity, and boiled linseed oil to render the whole sufficiently flexible. This composition is spread upon linen while hot, printed with any pattern desired. The surface is then treated with a solution of alum, sulphate of iron, copper, or zinc. These saline solutions may likewise be mixed with the composition before it is spread on the linen. The surface is lastly varnished, and may be bronzed or gilt. Another composition is obtained by boiling linseed oil with quicklime and borax, which forms a liquid that, on cooling, becomes a thick paste. It is then mixed with rasped cork and more quicklime.

(10465) B. M. L. asks how to make kindlings. A. 1. Save the corn cobs for kindlings, especially if wood is not going to be plentiful next winter. To prepare them, melt together 60 parts resin and 40 parts tar. Dip in the cobs and dry on sheet metal heated to about the temperature of boiling water. 2. Dip the wood in melted resin. The following composition is sometimes used: 60 parts melted resin and 40 parts tar, in which the wood is dipped for a moment. Or, take 1 quart of tar and 3 pounds of resin, melt them, then cool; mix as much sawdust with a little charcoal added as can be worked in. Spread out on a board and when cold break up into lumps the size of a hickory nut, and you will have enough kindling to last a good while.

(10466) R. N. P. asks how to smooth parchment. A. To smooth parchment which has become wrinkled, place the parchment face down upon clean blotting paper. Beat up to a clear froth, with a few drops of clove oil, the whites of several fresh eggs, and with the fingers spread this over the back of the sheet and rub it in until the parchment becomes smooth and yielding. Then spread it out as smooth as possible, cover with oil silk and press for a day. Then remove the silk and cover with a linen cloth and press with a warm iron.

(10467) M. J. L. asks how to ascertain the area and square inches and pounds upon the seat of an inch and one-half safety valve, that blows at 80 pounds, and how the decimal 0.7854 is got, and what kind of measurement for getting same. A. The area of the safety valve is the square of the diameter multiplied by 0.7854, which is the proportion of the area of a square to a circle of the same diameter. The area multiplied by 80 pounds is the total pressure. See Le Van's book on the safety valve, $2 by mail, which gives full details and computations for pressure, weight and its place on the beam.

(10468) W. N. P. asks: What metals will expand and contract the most with heat, and at what temperature and to what extent? A. Of the commercial metals, lead, magnesium, and zinc expand most for a given change of temperature. Lead and zinc expand 29 millionths for a change of 1.8 degrees Fahr., while magnesium expands 27 millionths. This is at about 100 degrees temperature. Of course the contraction upon cooling is the same as the expansion on heating.

(10469) L. B. asks how red printing ink may be removed from paper. A. Soak pieces of blotting paper in benzine, turpentine, or ether and apply successively, using each time a fresh clean piece of the blotting paper; this is preferable to rubbing with these solvents, as rubbing tends to spread the ink and also to loosen the fibers of the paper.

(10470) J. J. K. writes: Some plates for flat feet are made of spring steel covered with leather. The sweat of the feet soon rusts the plate. I have used paint and shellac, but they do not do much good. Please let me know what I can do to prevent rusting. A. Try a good copal coach varnish. If it can be done, an enamel baked on the plates will give the best satisfaction.

(10471) L. A. H. writes: I have some fine copper gas fixtures which have been finished with a bright thin coating called antique finish. This coating or polish has been destroyed to some extent by flies and other agencies. I would like to know of a process for restoring this polish to its original condition. A. Thoroughly clean the fixtures with benzine if necessary, and polish with any one of the usual polishes in the market. Then lacquer with the best quality of lacquer to be had, applying it in a thin coat with a soft brush.

(10472) G. L. Writes: Can acetylene gas and oxygen be burned together in a calcium jet for lime light, the same as hydrogen and oxygen lime light? And if not, why not? And if so, is it any more dangerous or explosive? A. Acetylene and oxygen can be used for the lime light. Hydrogen is now rarely used; ordinary illuminating gas is used, being sufficiently efficient and much cheaper. There is no more danger when using acetylene, provided the apparatus is in proper order, than with either illuminating gas or hydrogen.

(10473) G. C. asks for a formula for the making of a powder which extinguishes fire. A. Bicarbonate of soda mixed with 5 per cent to 10 per cent of mineral matter to prevent caking by absorption of moisture from the air, is useful. A mixture of dry bicarbonate of soda and dry sal ammoniac, if kept in a dry place, is still more effective. In confined spaces, as closed rooms, a different type of extinguisher is effective. It is based on the principle of fighting fire with fire. The following formula is good: Niter 60 parts, sulphur 36 parts, and charcoal 4 parts.

(10474) F. V. N. wishes a formula for producing a rich, red color on copper, for umbrella mountings. A. A gradually increasing temperature in a hot-air bath will give a series of colors as follows: Light-burnish orange, red-burnish orange, rose red, violet, steely white, light yellow, dark yellow. Both duration of heating and temperature affect the color obtained. As soon as the desired tint is produced, cool rapidly in air or by plunging into cold water. Colored varnishes are also used, but their effect is not permanent. There are various chemical ways of producing red browns, but none for a "rich red."

(10475) W. H. T. asks: How is gas made from water? Is there a book that would enable a foundry foreman to learn how to make an analysis of the iron in his castings? A. Briefly described, water gas is produced by blowing steam through a layer of brightly glowing coal; the water is decomposed, and the coal is consumed; the gases coming off are a mixture of hydrogen, carbon monoxide, and hydrocarbons, with small amount of carbonic dioxide, and variable amount of nitrogen. When the coal cools off too far to further decompose the water vapor, this is shut off, and air is blown through until the coal again burns brightly and is ready for more steam. While the air is blown in, the gases are allowed to escape up the chimney, as they have no value as illuminant, and in fact would not burn at all. The water gas as it comes from the producer has very little illuminating power. This is imparted to it by enriching with benzine.—There is no book which would explain to anyone not a chemist how to determine the amount of iron in brass or other castings. Such work must be done by a chemist. All books on analytical chemistry of the metals describe methods for this, but would be unintelligible to any person except a regular chemist.

(10476) R. G. P. asks: Are there any chime music boxes with a set of bells on them? How does the word chime get its name? A. The word chime comes from a Latin word, meaning bell, and also cymbal. Music boxes are made with sets of bells in them.

(10477) E. G. P. asks: How can a scratch be removed from the top of an oak table (highly polished)? A. If the scratch is only a slight, superficial one, it can usually be removed by rubbing with a rag soaked with crude oil. If a deep scratch, it will be best to rub down the whole top of the table with powdered pumice and crude oil, and then revarnish.

(10478) G. P. O. wishes a process for galvanizing such as is done on the base boards for stoves. A. The article to be galvanized is first thoroughly cleaned by dipping in weak muriatic or sulphuric acid, and is then thoroughly dried. After this it is plunged in a bath of molten zinc, wherein it becomes coated with a layer of zinc, being what is known as galvanized. The surface of the molten zinc must be kept clean by sprinkling with powdered sal ammoniac and skimming off the dross from time to time.

(10479) G. G. G. asks: How can I gild or mottle edges of books, to resemble as nearly as possible those gilded by publishers? A. To gild the edges of books, they are first trimmed smooth, then sized with egg albumen (white of egg) and gold leaf then applied. When dry it is burnished with agate burnisher. For mottling, a very thin solution of gum arabic is prepared in a tray, and the different colors are then shaken in or combed in. A half dozen or so of the books are held securely and evenly together, and the top, bottom and front edges are successively dipped in lightly, and the excess of color is each time blown off. Successful mottling is quite expert work.

(10480) W. J. D. asks: 1. Is there any method by which soft coal can be made into brick or lump form by mixing with other substances or by itself? A. The powdered or crushed soft coal can be pressed into bricks and then be partially coked to give strength. If the coal alone will not adhere sufficiently well on pressure, it can be mixed with pitch, and then partially coked. 2. Can the ordinary 150 deg. test kerosene oil be clarified to prevent

the strong smell while burning in a lamp or wick oil stove? A. A good quality of kerosene will not give much odor in burning in a lamp or wick oil stove, if care be taken to keep the wick well trimmed, and to adjust so that it will burn without smoke. There is no way of further purifying kerosene oil, as to make it burn without odor.

(10481) B. E. Co. asks: What kind of solder can be used to solder iron to iron that will in no way be affected by contact with quicksilver? Are there any other cheap metals besides iron that quicksilver will not affect? A. We know of no kind of solder which would not be more or less affected by mercury. Zinc and lead, which are the only other cheap metals, are both affected by mercury. Copper likewise.

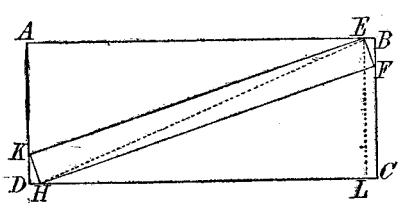
(10482) J. E. R. inquires whether or not a current water-wheel under a 3-foot hydraulic pressure, with paddles 10, 12, or 16 feet long by 3 or 4 feet wide, will run a 12-inch centrifugal pump, elevating water all told 12 feet (total lift 12 feet). The average fall of the stream is 10 feet per mile and it has a velocity of 6 feet per second. The diameter of waterwheel any size you may suggest. What would be the horse-power of a current water-wheel, length of paddle 14 feet long by 4 feet wide, and 16 feet in diameter? A. The 14-foot wide current wheel as described should give you 36 horse-power, and with a good centrifugal pump should raise 6,000 gallons of water 12 feet high per minute.

(10483) S. R. D. writes: Some time ago you published a formula for softening steel. A. To make steel very soft, heat to a full red for a few minutes, let it gradually cool until it turns black, then quench in warm water.

(10484) W. L. L. writes: In connection with my planing and lumber mill I have hundreds of tons of sawdust and shavings from the planers that I would like to utilize, but lack the necessary knowledge as to how to do it. I have been informed that you can give me the desired information as to what kinds or forms of petroleum or other material, and what kinds of machines, and where obtained, that it would be necessary to use in working this refuse up into marketable fuel. A. Mill shavings and sawdust have been compressed with coal tar, resin, or anything that will make the material stick together, but have been found too expensive unless other fuel was at very high price. In woodworking factories in the Eastern and Middle States, the whole product of the mill is burned under the boilers by enlarging the fire chamber by lowering the grate. Sawdust drawn to a bin by a fan blower, and wet by a water spray just enough to fix the dust, is shoveled directly into the fire chamber. Clean shavings are much utilized by baling and selling to stables for horse bedding.

(10485) N. L. writes: In the SCIENTIFIC AMERICAN of March 2, page 199, question 1, No. 10409, your author has made so many glaring mistakes in his reply as to merit a severe calling down. An occasional error is always pardonable, but a series of misstatements, given out as authority, likely to mislead the uneducated, surely needs a correction. You say: "If a vessel begins to sink, it must continue to sink until it reaches the bottom. Water is not compressed to any extent at greater depths than it is near the surface. If anything can sink at all in water, it will go to the bottom before it stops." All three of these statements are at variance with all known authorities in hydraulics. A hundred demonstrations are known to the average schoolboy to the contrary. Is it not an established fact that any body sinking in any liquid will sink until it reaches a point where the weight of the liquid above it will just balance the weight of the body, at which point it will rest? Your statements are all at variance with the long and well known law of upward pressure or buoyancy or liquids. This reply to question 1 would not be worthy of any great notice were it not for the fact that it may mislead a great number who may be reading your replies for knowledge they expect to be absolutely correct. The question is an old one, and, as you say of question 2, it "has traveled for a century," but you must remember that every year brings forth a new set of uneducated readers. A new generation comes up seeking knowledge, and it is hardly fair to ridicule even the most common of questions, *as you frequently do*. A. We do not know what data our correspondent has for his very positive statement contradicting our answer to query 10409. The compressibility of all materials is given in the reference tables. The latest and, we think, the best at our disposal is the Smithsonian Physical Tables, published under the authority of the Smithsonian Institution, Washington, D. C., the last edition of which was issued in 1903. On pages 82 and 83 will be found the compressibility of liquids and solids, for one atmosphere. The compressibility of sea water is given at 0.000044. The compressibility of several metals is given: Copper, 0,000086; lead, 0.000276; steel, 0.000068. All these are for one atmosphere or 15 pounds per square inch. It is seen that steel is 1½ times as compressible as sea water. By compression it increases more rapidly in density than does sea water, as it sinks in the ocean. Steel is about 7.8 times as heavy as water at the surface of the ocean, and will grow heavier by compression as it sinks in the ocean faster than the water in which it is sinking. It will therefore be everywhere heavier than water. Now, how much heavier is water at the bottom of the ocean than it is at the surface? The depth of the deepest place yet found in the Pacific is off the Fiji Islands as given by Prof. Davis, of Harvard University, in his Physical Geography, and is 30,930 feet. The same most reliable authority gives the deepest sounding in the Atlantic as 27,366 feet. Allowing 34 feet of water as equal to an atmosphere, this depth will produce 910 atmospheres, and will compress sea water 910 x 0.000044 of its volume. This is 1/25 part, and a cubic foot of sea water, which weighs 64 pounds at the surface of the ocean, will at the bottom of the deepest place yet found weigh 66.56 pounds. Under the same pressure a cubic foot of steel, which weighs about 487 pounds at the surface of the ocean, will at the bottom of the deepest place yet found have its weight increased 0.062 part, and it will there weigh 517.29 pounds. At the deepest place in the ocean yet found a cubic foot of steel will weigh 450.73 pounds more than a cubic foot of water at the same place. Will steel sink in water at the bottom of the ocean? We think it will. Now steel is compressed less by pressure than other metals and materials, and hence other materials will be less likely to float somewhere between the surface and the bottom of the ocean than steel is. Finally, we may be permitted to quote Prof. Davis's words on this very point: "Although water is easily moved, it is very little reduced in volume even when compressed by great force. Hence, in spite of the great pressure of the upper layers of the ocean on those beneath, the ocean is of nearly uniform density from top to bottom. *Anything which is heavy enough to sink at the top will sink all the way to the bottom.*" We are content to be classed with Prof. Davis in making "so many glaring mistakes as to merit a severe calling down" by our esteemed correspondent. Now we wait for him to produce his "authorities in hydraulics." We do not know any demonstration to the contrary, and we have been teaching hydraulics for forty years. Will N. L. tell us some of his hundred? The question which he puts at the close of his letter we answer, No, nothing of the kind. A floating body sinks till it has displaced its weight of water. A body heavier than water, volume for volume, such as a stone, does not displace its weight of water anywhere. It displaces its volume of water; and as its volume of water weighs less than the stone itself weighs, the stone sinks, and will continue to sink to the bottom. So will our ship in five miles of water, since every ballasted vessel even of wood will be heavier than its volume of water if water gets into the interior and drives out the air from the ship. Now as to ridicule; we would ask our readers to refer to the answer and see if they can discern any attempt to hold the inquirer up for a laugh at his expense. We cannot see any attempt to make any sport upon the matter. Certainly there is no attempt to raise a laugh on the questioner. As to the frequent requests to answer questions whose answers have been in our columns within a year or so, we must say that our readers ought to keep their files of papers, and before sending in a question go through the papers and see if they cannot find the answer without requiring a separate letter written to them.

(10486) I. J. P. writes: I send herewith a solution to the problem asked for in Notes and Queries No. 10198, and would like the asker's address if it is all right to ask it. I have used algebra. I do not see how he could think to use calculus, since the required number is a constant, although more than one value, as may be noted by revolving the inner rectangle on its center or by the equation of the fourth degree.



Problem: In a given rectangle 10×20 feet inscribe diagonally a rectangle 2 feet wide, to find its length.

In given rectangle, A B C D, to inscribe E F H K, given the length of E F (= H K), required length E K (= F H).

Triangles E B F and F C H are similar and right triangles.

$\therefore$ E B : B F :: F C : C H or $\overline{EB} \times \overline{CH} = \overline{BF} \times FC$ in which

$$CH = CD - DH = CD - EB,\ FC = BC - BF$$

$$\therefore \overline{EB}(CD - EB) = BF(BC - BF) \quad (1)$$

and $$\overline{EB}^2 + \overline{BF}^2 = \overline{EF}^2 \quad (2)$$

From (1) and (2) eliminate B F and arrange for E B.

$$\therefore 4\overline{EB}^4 - 4\overline{DC} \times \overline{EB}^3 + (\overline{BC}^2 + \overline{DC}^2 - 4\overline{EF}^2)\overline{EB}^2 + 2\overline{DC} \times \overline{EF}^2 \times \overline{EB} - \overline{BC}^2 \times \overline{EF}^2 + \overline{EF}^4 = 0.$$

Given DC = 20, BC = 10, EF = 2, which substitute, and $\div 4$.

$$\therefore \overline{EB}^4 - 20\,\overline{EB}^3 + 121\overline{EB}^2 + 40\overline{EB} - 96 = 0.$$

$$\therefore \overline{EB} = 0.7816258.$$

Draw E L parallel to B C. Draw E H and in right triangles E F H and E L H, $\overline{HF}^2 + \overline{EF}^2 = \overline{EL}^2 + \overline{LH}^2$, in which EF = 2, EL = 10, LH = DH − (DH + LC) = DH − 2EB = 20 − 1.5632516.

$\therefore \overline{HF}^2 = 10^2 + (18.4367484)^2 - 2^2 = 435.9138916$, and HF = 20.88094566.

Giving the required length as 20 feet 10.57 inches.

A. We give a correct solution to the problem of inscribing a rectangle of a given width in another rectangle. It is not our policy to give much space to the solution of mere mathematical problems. There are good mathematical journals devoted to that work. Some physical or mechanical problems are legitimate to our purposes, and to these we usually give attention, although we cannot spend much time in digging out puzzles. We add the remarks upon the solution of the problem above by Mr. L. Leland Locke, Adelphi College, Brooklyn, N. Y. He shows the impossibility of having more than one rectangle of the greatest length inscribed in another rectangle. The matter was referred to him since I. J. P. states in his letter that there may be more than one longest rectangle in this case. The solution of the problem given above is correct in principle. We have not verified the numerical work. This is not a problem of maxima as stated by the proposer of the problem in the original note, for the reason that there is but one rectangle which meets the conditions of the problem. If a rectangle of a given width be turned so that E and F, vertices of one end, remain respectively in sides A B and B C of larger rectangle, and point K with K E variable follows line A D, there is but one position in which H will be on C D; in other words, the path of H is a curve which cuts C D but once, and hence only one rectangle with a width of 2 feet can be inscribed in a given rectangle all of whose vertices are upon the sides of the given rectangle. This is also shown by the fact that the biquadric equation yields but one positive and real root. Its other real root is negative. If it were possible to revolve a rectangle of given width and variable length, keeping its corners on the sides of a larger rectangle, it would be impossible to secure a determinate equation involving its length.

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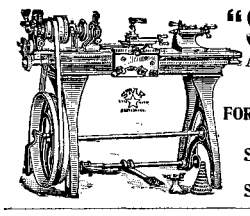

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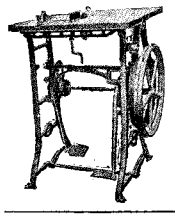

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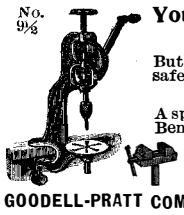

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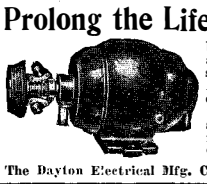

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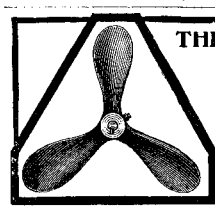

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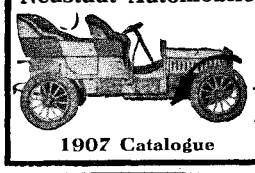

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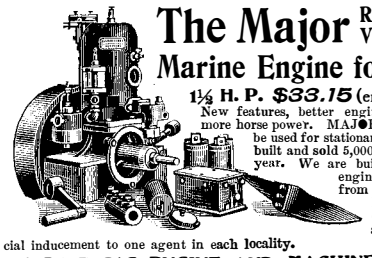

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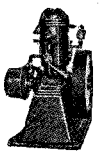

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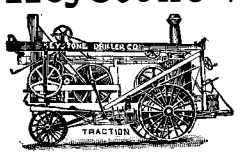

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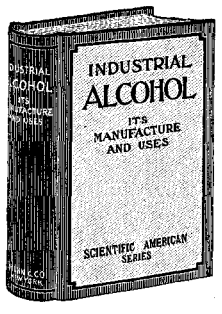

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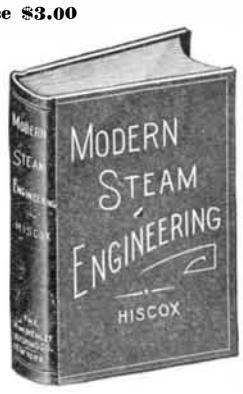

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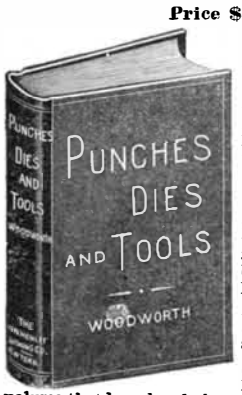

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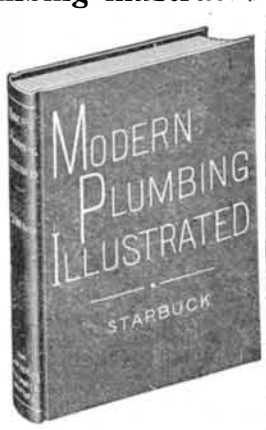

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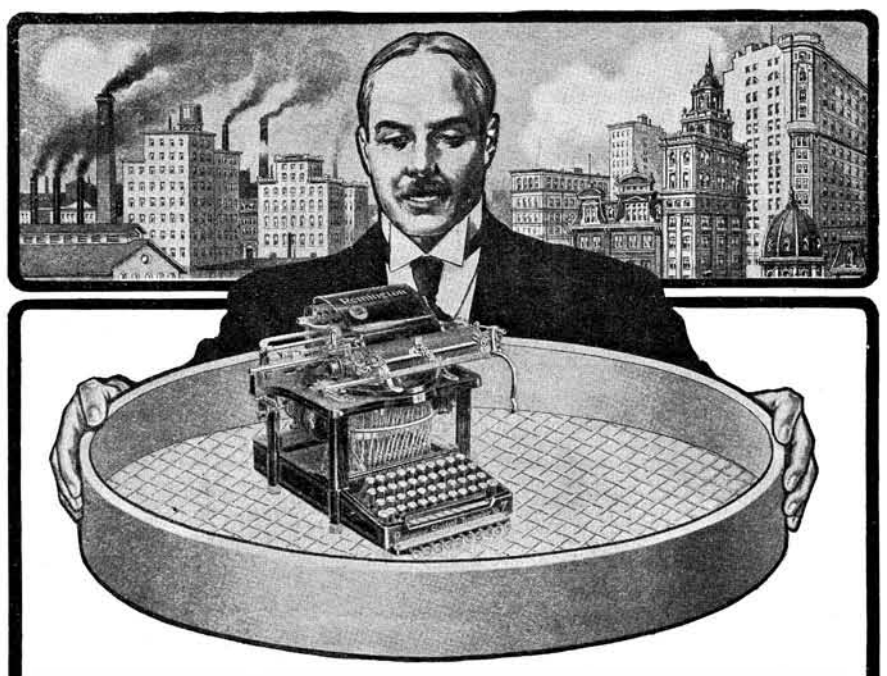

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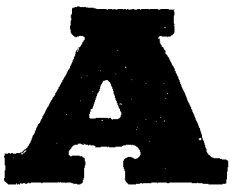

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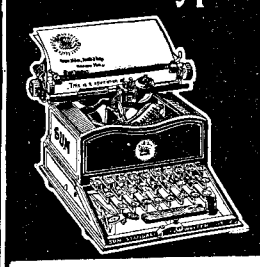

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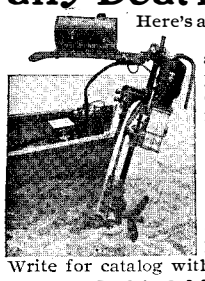

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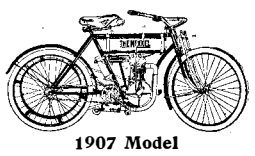

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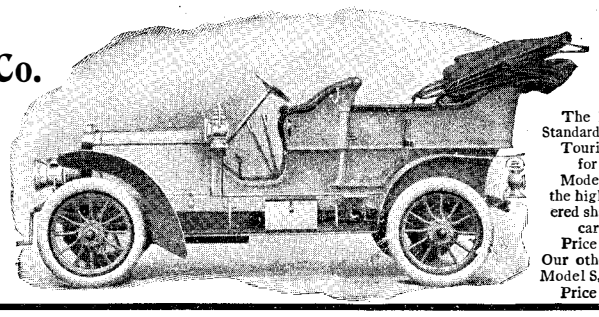

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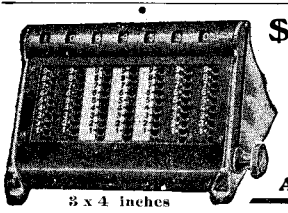

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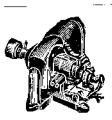

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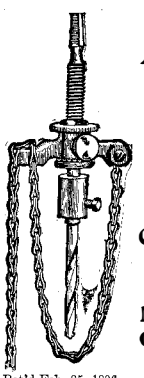

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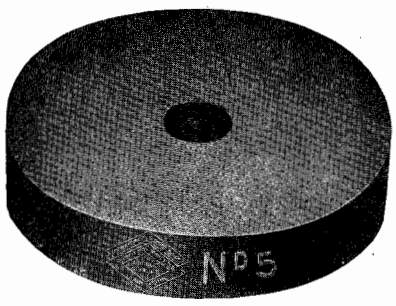

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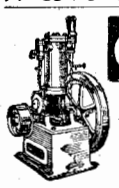

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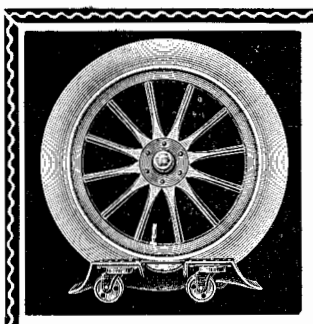

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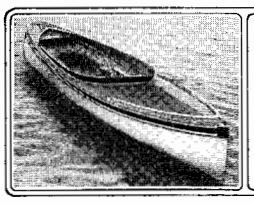

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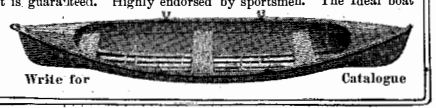

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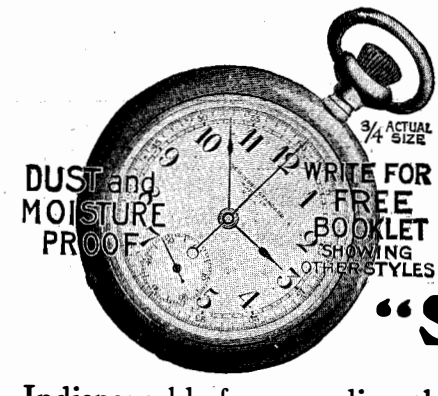

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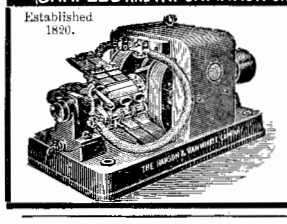

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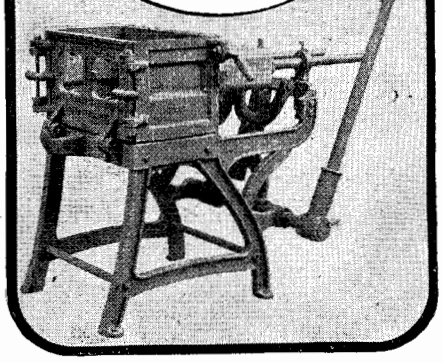

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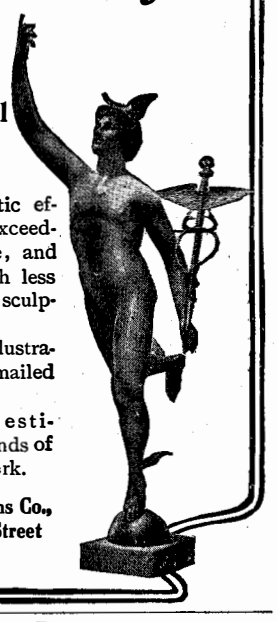

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